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Tomoike

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(54) **MOBILE COMMUNICATION SYSTEM AND A METHOD OF INCOMING CALL RESTRICTION**

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(73) Assignee: **NEC Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/124,073**

(22) Filed: **Jul. 29, 1998**

(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**[7] **H04B 7/00**
(52) **U.S. Cl.** **455/411**; 455/435; 455/445
(58) **Field of Search** 455/423, 424, 455/422, 410, 411, 426, 432, 433, 435, 445

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,085,084 * 7/2000 Christmas 455/411

FOREIGN PATENT DOCUMENTS

3-42950 2/1991 (JP) .

* cited by examiner

Primary Examiner—Thanh Cong Le
(74) *Attorney, Agent, or Firm*—McGuireWoods LLP

(57) **ABSTRACT**

A mobile communication system which can restrict incoming calls to a mobile communication exchange in a traffic congestion state and can omit wasteful processing for connecting a path to a restricting exchange is provide. When a exchange has detected that it is the traffic congestion state, the exchange instruct this state to a location register to indicate that incoming calls to that exchange are to be restricted. When other exchange has received a call request to a mobile station, the exchange acquires information to the location register for the call. When it is found that the location information of the mobile station is the area which is controlled by the incoming call restricting exchange, a call processing for the call is interrupted.

6 Claims, 3 Drawing Sheets

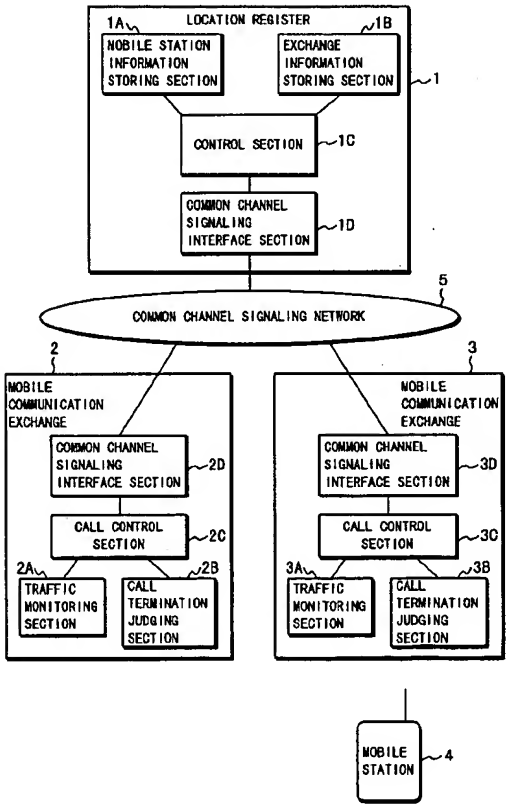


Fig. 1

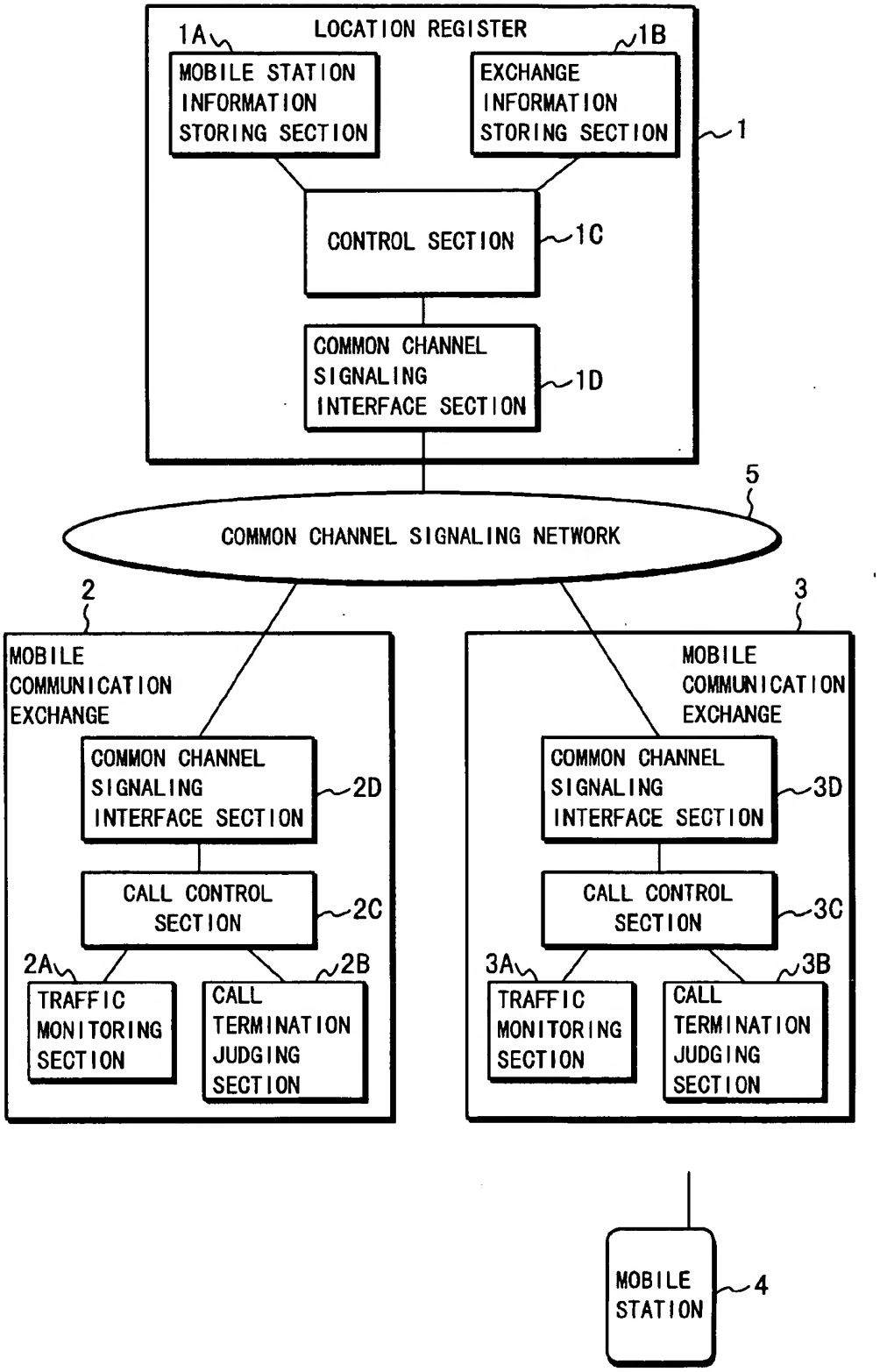

LOCATION REGISTER
1A
1B
MOBILE STATION INFORMATION STORING SECTION
EXCHANGE INFORMATION STORING SECTION
1
CONTROL SECTION
1C
COMMON CHANNEL SIGNALING INTERFACE SECTION
1D
5
COMMON CHANNEL SIGNALING NETWORK
2
3
MOBILE COMMUNICATION EXCHANGE
COMMON CHANNEL SIGNALING INTERFACE SECTION
2D
CALL CONTROL SECTION
2C
2A
2B
TRAFFIC MONITORING SECTION
CALL TERMINATION JUDGING SECTION
MOBILE COMMUNICATION EXCHANGE
COMMON CHANNEL SIGNALING INTERFACE SECTION
3D
CALL CONTROL SECTION
3C
3A
3B
TRAFFIC MONITORING SECTION
CALL TERMINATION JUDGING SECTION
MOBILE STATION
4

Fig. 2

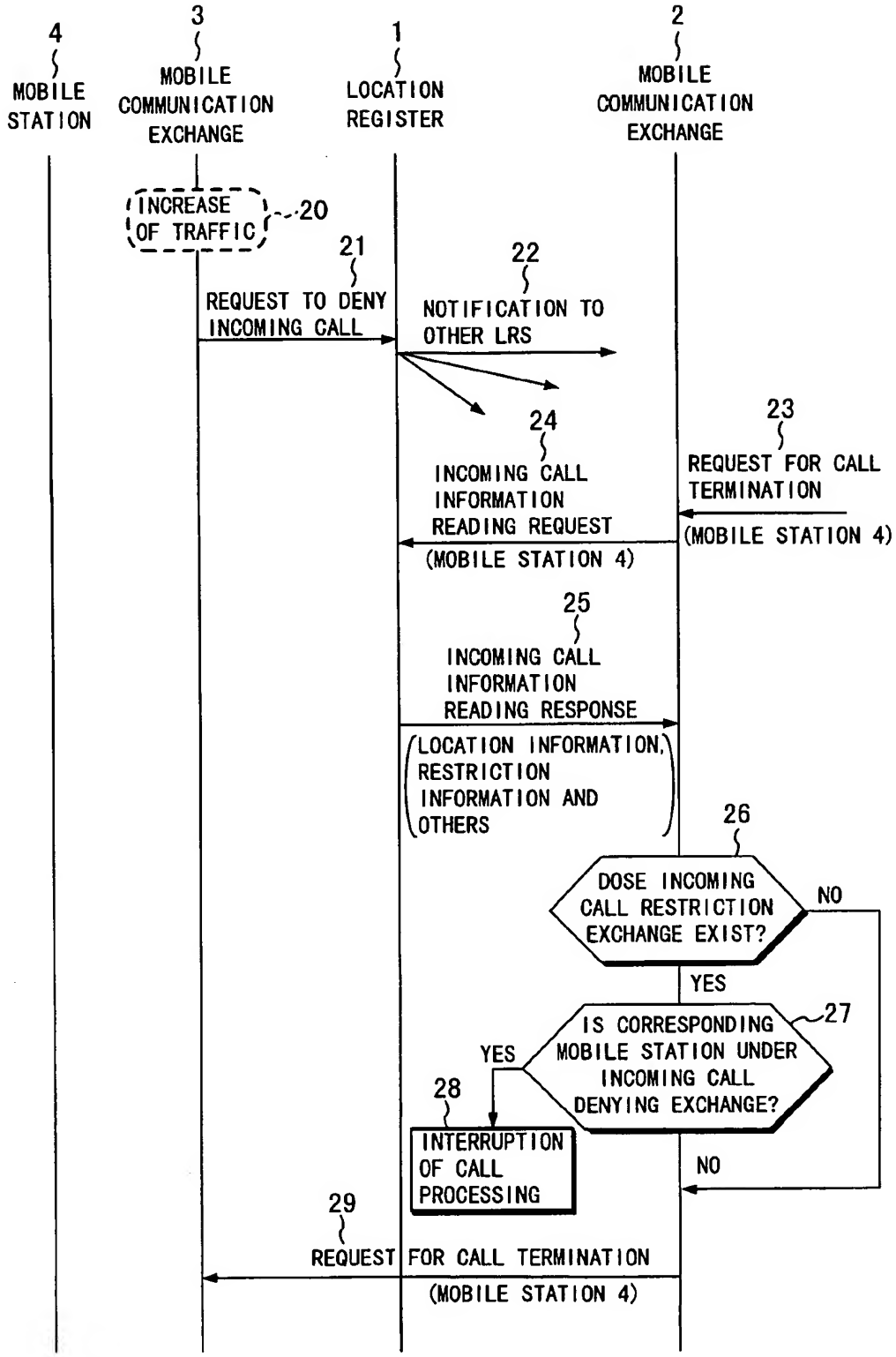

4
MOBILE STATION
3
MOBILE COMMUNICATION EXCHANGE
1
LOCATION REGISTER
2
MOBILE COMMUNICATION EXCHANGE
INCREASE OF TRAFFIC
20
21
REQUEST TO DENY INCOMING CALL
22
NOTIFICATION TO OTHER LRS
23
REQUEST FOR CALL TERMINATION
(MOBILE STATION 4)
24
INCOMING CALL INFORMATION READING REQUEST
(MOBILE STATION 4)
25
INCOMING CALL INFORMATION READING RESPONSE
(LOCATION INFORMATION, RESTRICTION INFORMATION AND OTHERS
26
DOSE INCOMING CALL RESTRICTION EXCHANGE EXIST?
NO
YES
27
IS CORRESPONDING MOBILE STATION UNDER INCOMING CALL DENYING EXCHANGE?
YES
28
INTERRUPTION OF CALL PROCESSING
NO
29
REQUEST FOR CALL TERMINATION
(MOBILE STATION 4)

Fig. 3 PRIOR ART

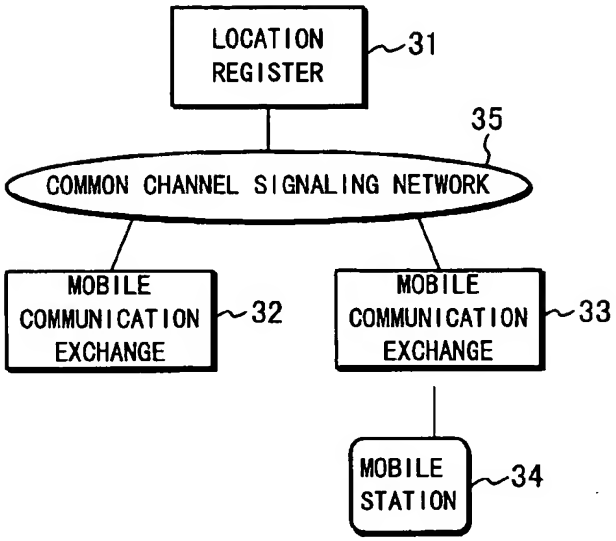
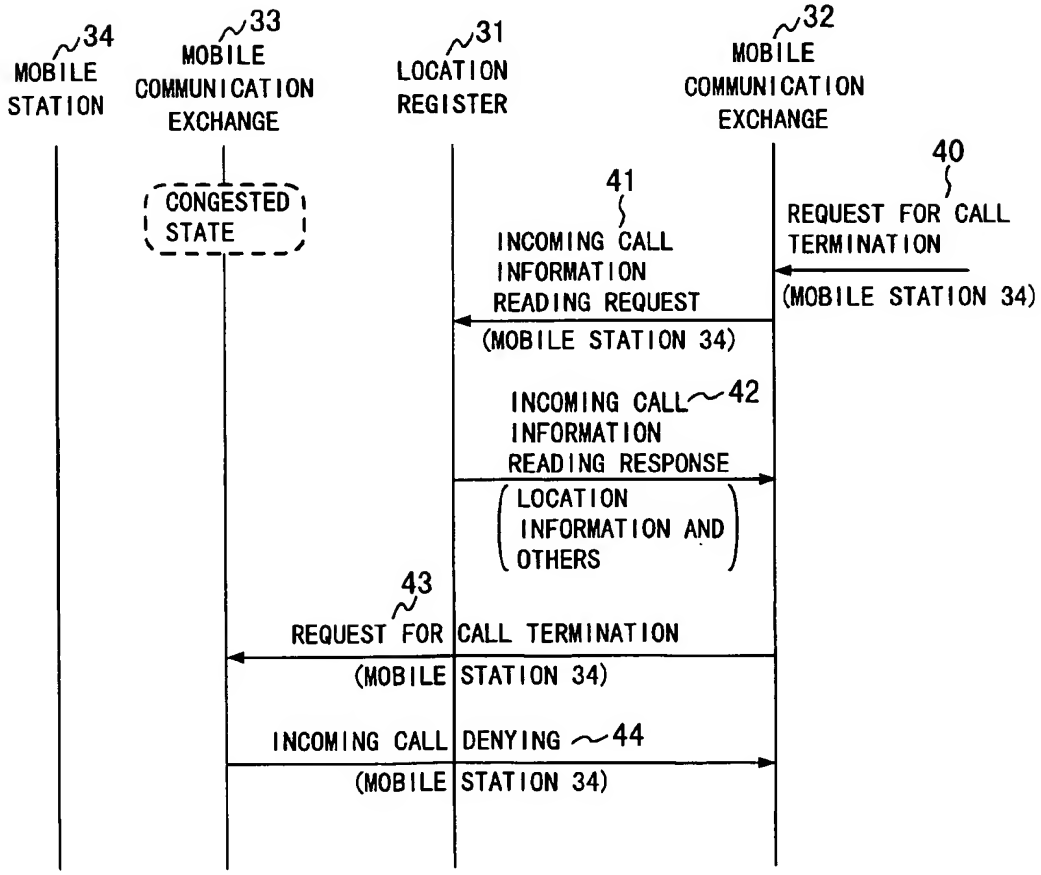


Fig. 4 PRIOR ART



MOBILE COMMUNICATION SYSTEM AND A METHOD OF INCOMING CALL RESTRICTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a mobile communication system, particularly relates to a mobile communication system and a method for restricting incoming calls when a particular mobile communication exchange is under traffic congestion state.

2. Description of the Related Art

A block diagram of constitution of a general mobile communication system focusing to a network side is shown in FIG. 3.

A location register **31**, which manages location information and subscriber information of each mobile station **34**, is respectively connected to mobile communication exchanges **32** and **33** for call connecting processing via a common channel signaling network **35** and information required for the processing of an incoming call to each mobile station **34** is mutually communicated via the common channel signaling network **35**. Although radio base stations and radio base station control units are not shown in drawings, it is assumed that they are part of the mobile communication exchange **32**, **33**.

In this type of mobile communication system, if the traffic of a specific mobile communication exchange has increased and congestion state occurs, the specific mobile communication exchange is relieved from such a congestion state by restricting an incoming call to the above mobile communication exchange from other mobile communication exchanges and restricting or denying a call origination request from mobile stations under control of the mobile communication exchange through radio base stations (not shown).

FIG. **4** is a sequence diagram showing a conventional type incoming call control method.

Suppose that the mobile communication exchange **33** which controls the mobile station **34** is in a state of congestion.

At this time, when one of the mobile communication exchanges of the mobile communication network, e.g. the mobile communication exchange **32**, receives a request **40** for call termination to the mobile station **34**, which is under control of the mobile communication exchange **33**, the mobile communication exchange **32** sends an incoming call information reading request **41** to the location register **31** through the common channel signaling network **35**.

The mobile communication exchange **32** acquires the location information of the mobile station **34** based upon an incoming call information reading response **42** returned from the location register **31** in response to the above request.

The mobile communication exchange **32** recognizes that the mobile station **34** is located in area under control of the mobile communication exchange **33**, and sends a request for call termination **43** to the mobile communication exchange **33**.

On the other hand, the mobile communication exchange **33** receives the request **43** for call termination to the mobile station **34**, however, as the mobile communication exchange **33** itself is in a state of congestion, the mobile communication exchange **33** returns an incoming call denying signal **44** to the mobile communication exchange **32**. Hereby, processing for the call in the mobile communication exchange **32** is interrupted, and the call is treated as a call loss.

However, in such a conventional type mobile communication system, as processing for an incoming call to a mobile station located in an area under control of a mobile communication exchange, which is in a state of congestion, is advanced up to the mobile communication exchange, and the incoming call request is denied by the mobile communication exchange. That is, the mobile communication exchange in a state of congestion is required to execute processing for denying the incoming call. Therefore, such processing for rejecting the incoming call by the mobile communication exchange in a state of congestion causes a problem that a mobile communication exchange in a state of congestion is prevented from recovering from the congestion.

To solve the above problem, Japanese Patent Publication Laid-open No. Hei 3-42950 discloses a technology that incoming calls to an exchange in a state of congestion are rejected at an exchange of the preceding stage which is notified by the exchange in a state of congestion that the exchange is currently being in a state of congestion. Hereby, as incoming calls to an exchange in a state of congestion are restricted at the preceding exchange, the above problem can be solved, however, there is a problem that wasteful processing for incoming calls routed up to the preceding exchange cannot be reduced.

SUMMARY OF THE INVENTION

The present invention is made to solve such problems and therefore has an object to provide a mobile communication system which can restrict incoming calls to an exchange in a state of congestion and can omit wasteful processing for connecting to a restricting exchange.

To achieve such an object, a mobile communication system according to the present invention is constituted so that a location register stores incoming call restricting exchange information showing a mobile communication exchange which is under incoming call restricting state; and a mobile communication exchange, when received a call request, acquires a mobile station information including location information and incoming call restricting exchange information to the location register for the received call request, and verifying whether the call terminating process being allowed or not in accordance with the query result.

In more detail, the location register according to the present invention comprises an incoming call restricting exchange information storage section for storing an exchange information showing a mobile communication exchange is under incoming call restricting state due to traffic over load condition or like, and the mobile communication exchange comprises an incoming call judging section for judging whether a call to a mobile station is allowed or not by referring to information including location information of the mobile station and incoming call restricting exchange information obtained from the location register.

Therefore, each mobile communication exchange comprises means for detecting traffic state of own exchange and instructing the traffic congestion state to the location register, and means for judging whether a call to a mobile station is allowed or not according to information obtained from the location register when a call request has been received, and means for interrupting call processing in accordance with a result of judgement which has judged that the mobile station was located in a control area of the mobile

communication exchange indicated by the incoming call restricting exchange information.

A method of incoming call restriction for a mobile communication system according to the present invention comprises the following steps;

(1) instructing the location register to store an incoming call restricting exchange information when traffic state of a mobile communication exchange exceeding a predetermined value for rejecting incoming calls to mobile stations located in own control area:

(2) storing the incoming call restricting exchange information in the location register showing that a mobile communication exchange is under incoming call restricting state;

(3) acquiring information to the location register when a mobile communication exchange has received a call request to a mobile station;

(4) judging whether a call to the mobile station is allowed or not according to information from the location register including location information of the mobile station and incoming call restricting exchange information; and

(5) interrupting call processing when it has judged the mobile station is locating in a control area of the mobile communication exchange indicated by the incoming call restricting exchange information.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing a mobile communication system equivalent to an embodiment of the present invention;

FIG. **2** is a sequence diagram showing incoming call control processing according to the present invention;

FIG. **3** is a block diagram showing a general mobile communication system; and

FIG. **4** is a sequence diagram showing a conventional type incoming call control processing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Next, referring to the drawings, the present invention will be described.

FIG. **1** is a block diagram showing a mobile communication system equivalent to an embodiment of the present invention.

The location information and subscriber information of each mobile station **4** are managed by a location register (LR) **1**.

The location register **1** is connected to mobile communication exchanges **2** and **3** for executing call connecting processing via a common channel signaling network **5** and information required for the processing of an incoming call to the mobile station **4** is mutually communicated via the common channel signaling network **5**.

Although radio base stations and radio base station control units are not shown in drawings, it is assumed that they are part of the mobile communication exchange **2**, **3**.

The location register **1** is provided with a mobile station information storing section **1A** for storing the location information of each mobile station **4**, an exchange information storing section **1B** for storing exchange information which is restricting incoming calls due to traffic congestion or some other reasons, a control section **1C** for executing response processing for a request to acquire mobile station information from the mobile communication exchange, for example, a request to acquire information such as the location information and subscriber information of the mobile station **4**, and a common channel signaling interface (I/F) section **1D** for providing an interface with the common channel signaling network **5**.

The mobile communication exchanges **2** and **3** are respectively provided with call control sections **2C** and **3C** for executing call connecting processing, common channel signal interface (I/F) sections **2D** and **3D** for providing an interface with the common channel signaling network **5**, traffic monitoring sections **2A** and **3A** for monitoring the quantity of their own traffic (traffic intensity), and call termination judging sections **2B** and **3B** for judging the interruption or the continuation of call processing based upon exchange information under incoming call restriction acquired from the location register **1**.

Next, referring to FIG. **2**, the operation according to the present invention will be descried.

FIG. **2** is a sequence diagram showing an incoming call control method according to the present invention.

The traffic monitoring sections **2A** and **3A** of the mobile communication exchanges **2** and **3** always monitor the quantity of their own traffic. If the increase **20** of traffic occurs in the mobile communication exchange **3** and the quantity of traffic exceeds a predetermined threshold, the traffic monitoring section **3A** notifies the call control section **3C** of the situation of traffic and instructs the restriction of incoming call from other mobile communication exchanges and requests of call origination from mobile stations in the own control area. The call control section **3C** sends a request to deny incoming call **21** to the location register **1** via the common channel signaling interface (I/F) section **3D** and the common channel signaling network **5** if the call control section **3***c* judges, based upon the notification from the traffic monitoring section **3A**, that the restriction of incoming calls is required. When a plurality of location registers are provided in the mobile communication network, the request to deny incoming call **21** is sent to all those location registers.

The request to deny incoming call **21** from the mobile communication exchange **3** is received by the common channel signaling (I/F) section **1D** of the location register **1** and notified to the control section **1C**. The control section **1C** stores information that the mobile communication exchange **3** is restricting incoming calls in the exchange information storing section **1B** based upon the notified request to deny incoming call **21**.

Afterward, if a request for call termination **23** to a mobile station **4**, which is located-in the control area of the mobile communication exchange **3**, is received by the mobile communication exchange **2**, the call control section **2C** of the mobile communication exchange **2** sends an incoming call information reading request **24** including the mobile station identification number of the mobile station **4** to the location register **1** to obtain the location information of the mobile station **4**.

The location register **1**, which has received the incoming call information reading request **24**, returns an incoming call information reading response **25** to the mobile communication exchange **2** as a response on the basis of information stored in the mobile station information storing section **1A** and the exchange information storing section **1B**. Therefore, the location information of the mobile station **4**, and also information of exchanges which are under incoming call restriction are included in the incoming call information reading response **25**.

The call termination judging section 2B of the mobile communication exchange 2, which has received the incoming call information reading response 25, analyzes an incoming call based upon the location information of the mobile station 4 and incoming call restriction exchange information whether the incoming call is to be processed or interrupted.

First, a judgement 26 is made as to whether any of exchanges under incoming call restriction exist or not.

As the mobile communication exchange 3 is restricting incoming call ("YES" in the judgment 26), next, a judgement 27 is made as to whether the mobile station, to which the incoming call is supposed to be terminated, is located in the control area of the incoming call restriction exchange or not.

In this case, as the mobile station 4 is located in the control area of the mobile communication exchange 3 which is currently restricting incoming calls ("YES" in the judgment 27), it has judged that call connecting processing cannot be continued, and notification thereof is made to the call control section 2C. In response, the call control section 2C decides not to send a request for call termination to the mobile communication exchange 3 and carries out interruption 28 of processing for the incoming call to the mobile station 4.

Therefore, as the request for call termination is not sent to the mobile communication exchange 3 under state of congestion, the load of wasteful processing caused by a request for call termination in the mobile communication exchange 3 can be prevented from being increased and delay in the recovery from congestion can be reduced.

If the mobile station 4 is not located in the control area of the mobile communication exchange 3 of incoming call restriction in the judgment 27 ("NO" in the judgment 27) and if no mobile communication exchange which is restricting incoming calls exists in the judgment 26 ("No" in the judgment 26), the call termination judging section 2B judges that call control processing can be continued. Hereby, the call control section 2C sends a request for call termination 29 to the mobile communication exchange 3 under which a mobile station 4 exists.

As described above, according to the present invention, as information of mobile communication exchange which is restricting incoming calls is stored in a location register which is managing the location information of each mobile station, and is notified to a mobile communication exchange which has inquired information for a mobile station to which an incoming call is to be terminated, the incoming call to the mobile communication exchange in a state of congestion can be rejected at the mobile communication exchange which has firstly received a request for the call.

Therefore, the increase of the load of wasteful processing for a mobile communication exchange in a state of congestion can be avoided, delay in the recovery from a congested state can be reduced and the resources of the whole mobile communication network can be efficiently utilized.

Although the present invention has been fully described by way of the preferred embodiments thereof with reference to the accompanying drawings, various changes and modifications will be apparent to those having skill in this field. Therefore, unless these changes and modifications otherwise depart from the scope of the present invention, they should be construed as included therein.

What is claimed is:

1. A mobile communication system provided with at least one location register for managing mobile station information such as location information of each mobile station and subscriber information and a plurality of mobile communication exchanges for executing call connection processing by mutually communicating mobile station information with said location register via a common channel signaling network, wherein:

said location register comprising an incoming call restricting exchange information storage section for storing an exchange information showing a mobile communication exchange being under incoming call restricting state; and

said mobile communication exchange comprising a call processing section for acquiring a mobile station information including location information and incoming call restricting exchange information from said location register for a call being processed, and interrupting a call processing of said mobile communication exchange under incoming call restricting state based on said mobile station information and incoming call restricting exchange information.

2. A mobile communication system provided with at least one location register for managing mobile station information such as location information of each mobile station and subscriber information and a plurality of mobile communication exchanges for executing call connecting processing by mutually communicating mobile station information with said location register via a common channel signaling network, wherein:

said location register comprising an incoming call restricting exchange information storage section for storing an exchange information showing a mobile communication exchange being under incoming call restricting state; and

said mobile communication exchange comprising a traffic monitoring section for monitoring traffic state of own mobile communication exchange and instructing said location register to store the incoming call restricting exchange information when traffic state exceeding a predetermined value for rejecting incoming calls to mobile stations located in own control area, and an incoming call judging section for interrupting a call processing of said mobile communication exchange under incoming call restricting state based on said mobile station information and incoming call restricting exchange information from said location register.

3. A mobile communication system according to claim 2, wherein; said incoming call judging section judging a call process to be denied when the mobile station being located in a control area of the mobile communication exchange indicated by the incoming call restricting exchange information.

4. A mobile communication system comprising:

at least one location register for managing mobile station information, such as location information of each mobile station and subscriber information, and storing an exchange information showing a mobile communication exchange being under incoming call restricting state;

a plurality of mobile communication exchanges for executing call connecting processing by mutually communicating mobile station information with said location register via a common channel signaling network, and each mobile communication exchange comprising:

a traffic monitoring section for monitoring traffic state of own mobile communication exchange and instructing said location register to store the incoming call restrict-

ing exchange information when traffic state exceeding a predetermined value for rejecting incoming calls to mobile stations located in own control area;

an incoming call judging section for interrupting a call processing of said mobile communication exchange under incoming call restricting state based on said mobile station information by acquiring result information including location information of the mobile station and incoming call restricting exchange information from said location register; and

a call processing section for interrupting call processing in accordance with a result of judgement of said incoming call judging section which has detected the mobile station being located in a control area of the mobile communication exchange indicated by the incoming call restricting exchange information.

5. A method of incoming call restriction for a mobile communication system provided with at least one location register for managing mobile station information such as location information of each mobile station and subscriber information and a plurality of mobile communication exchanges for executing call connecting processing by mutually communicating mobile station information with said location register via a common channel signaling network, said method comprising steps of:

storing incoming call restricting exchange information in said location register showing a mobile communication exchange which is under incoming call restricting state;

acquiring a mobile station information including location information and incoming call restricting exchange information from said location register when a call request being received; and

interrupting a call processing of said mobile communication exchange under incoming call restricting state based on said mobile station information and incoming call restricting exchange information.

6. A method of incoming call restriction for a mobile communication system provided with at least one location register for managing mobile station information such as location information of each mobile station and subscriber information and a plurality of mobile communication exchanges for executing call connecting processing by mutually communicating mobile station information with said location register via a common channel signaling network, said method comprising steps of:

instructing said location register to store an incoming call restricting exchange information when traffic state of a mobile communication exchange exceeding a predetermined value for rejecting incoming calls to mobile stations located in own control area;

storing the incoming call restricting exchange information in said location register showing a mobile communication exchange being under incoming call restricting state;

acquiring information to said location register when a mobile communication exchange has received a call request to a mobile station;

judging whether a call to the mobile station being allowed or not by acquiring result information including location information of the mobile station and incoming call restricting exchange information from said location register; and

interrupting call processing when it has judged the mobile station being located in a control area of the mobile communication exchange indicated by the incoming call restricting exchange information.

* * * * *

US006091949A

United States Patent [19]

Sanchez

[11] Patent Number: 6,091,949

[45] Date of Patent: Jul. 18, 2000

[54] **LOCATION TRIGGERED BARRING OF CALL FORWARDING**

[75] Inventor: **Juan Antonio Sanchez**, Madrid, Spain

[73] Assignee: **Telefonaktiebolaget LM Ericsson (publ)**, Stockholm, Sweden

[21] Appl. No.: **09/104,758**

[22] Filed: **Jun. 25, 1998**

[51] **Int. Cl.**[7] **H04Q 7/24**; H04M 1/64

[52] **U.S. Cl.** **455/417**; 455/410; 455/414; 455/433; 455/440; 455/26.1; 455/31.1; 379/210; 379/211; 379/212

[58] **Field of Search** 455/417, 410, 455/414, 433, 438, 440, 26.1, 31.1; 379/210, 211, 212

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,018,194	5/1991	Suzuki et al.	379/207
5,195,131	3/1993	Sano	379/211
5,347,574	9/1994	Morganstein	379/210
5,440,623	8/1995	Moore et al.	379/67
5,577,103	11/1996	Foti	379/59
5,610,973	3/1997	Comer	379/59
5,657,382	8/1997	Tamagawa et al.	379/211
5,815,808	9/1998	Valentine	455/414
5,873,034	2/1999	Alperovich et al.	455/432
5,878,338	3/1999	Alperovich et al.	455/417
5,933,774	8/1999	Bertocci	455/417
5,978,673	11/1999	Alperovich et al.	455/417

FOREIGN PATENT DOCUMENTS

9629839	9/1996	WIPO	H04Q 7/38
9634502	10/1996	WIPO	H04Q 7/24
9747152	12/1997	WIPO	H04Q 7/38
9826620	6/1998	WIPO	H04Q 7/00

OTHER PUBLICATIONS

Mitsubishi Electric Corp. Abstract "Mobile Communication System for Inter Mobile Network Communications . . . ", Accession No. 97–464654, Aug. 15, 1997.

GPT LTD Abstract "Telecommunications System With Interconnected Networks . . . ", G. P. Boot et al.; Accession No. 96–211790, May 23, 1996.

Siemens AG Abstract "Telephone Call Diversion Procedure . . . ", T. Lehmann; Accession No. 96–000785, Nov. 12, 1995.

Motorola Inc. Abstract "Telephone Subscriber Equipment User Location Method . . . ", J. M. Gilbert et al., Accession No. 95–016432, Dec. 2, 1994.

Nippon Telegraph & Telephone Corp. Abstract "Call Reception Transfer System for Mobile Communication Systems . . . ", Accession No. 96–348659, Jun. 21, 1996.

Accessline Technologies Inc. Abstract, "Computer Controlled Paging and Telephone Communications System . . . ", R. P. Berg, et al., Accession No. 96–188708, Mar. 28, 1996.

Siemens AG Abstract "Incoming Call Handling Method for Mobile Communication Network . . . ", K. F. Neubauer et al., Accession No. 96–355040, Aug. 1, 1996.

NEC Corp. Abstract, "Economic Communication Control in Multi Processing System . . . ", Accession No. 94–282356, Jul. 26, 1994.

Anonymous Abstract "Context–Dependent Script for Intergrated Communication Services . . . ", Accession No. 91–080164, Feb. 25, 1991.

Anonymous Abstract "Directory Service for Intergrated Communication Service System . . . ", Accession No. 90–122894, Mar. 25, 1990.

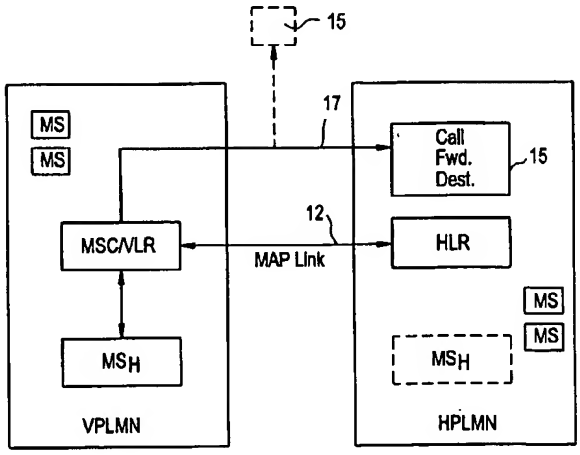
(List continued on next page.)

Primary Examiner—Lee Nguyen
Assistant Examiner—Simon Nguyen
Attorney, Agent, or Firm—Jenkens & Gilchrist, P.C.

[57] **ABSTRACT**

Call forwarding service provided to a wireless mobile communication station is controlled by barring call forwarding from the wireless mobile communication station selectively based on the location of the wireless mobile communication station.

32 Claims, 6 Drawing Sheets



OTHER PUBLICATIONS

Toshiba KK Abstract "Call forwarding Device for PBX Calls Telephone Final Transfer . . . ", Accession No. 87–324214, Oct. 8, 1987.

Fujitsu Ltd. Abstract "Incoming Call Forward Transfer Method by Calling Terminal . . . ", Accession No. 85–300781, Oct. 22, 1985.

Tokyo Shibaura Electric Co. "Call–forward Service Device is Capable of Making . . . ", Accession No. 83–C2786K, Jan. 10, 1983.

FIG.1

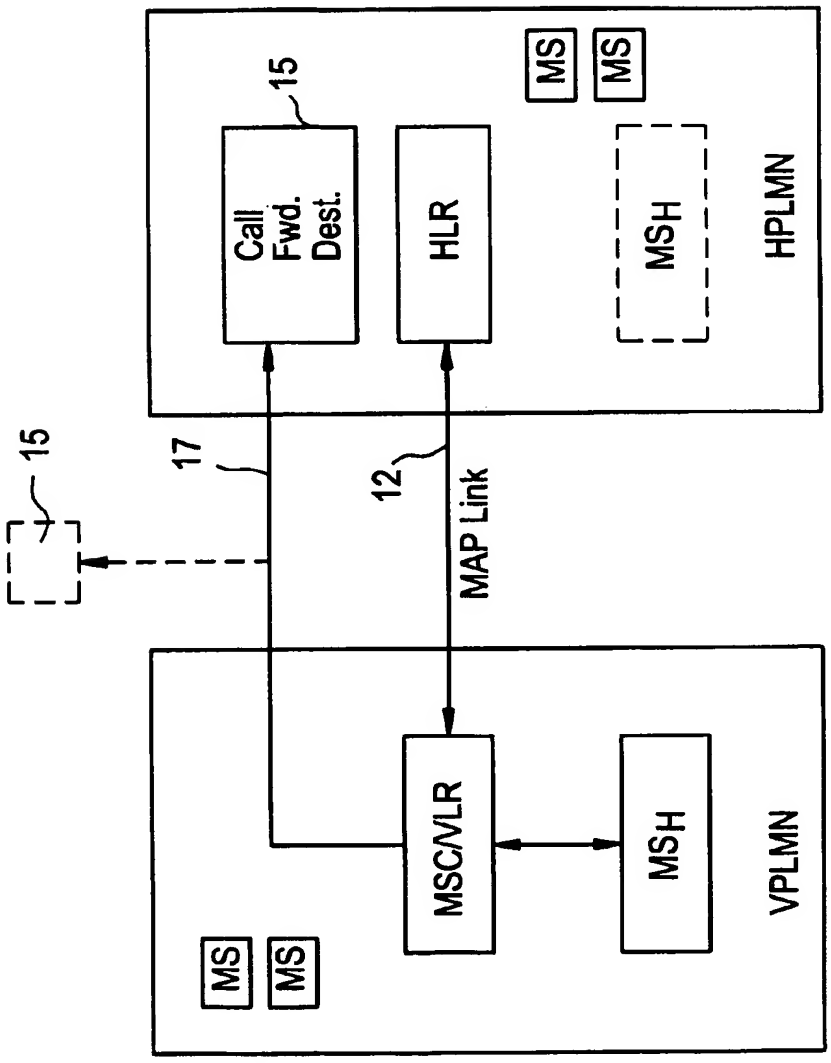

15
Call Fwd. Dest.
HLR
MS
MS
MSH
HPLMN
17
12
MAP Link
15
MSC/VLR
MSH
MS
MS
VPLMN

FIG.2

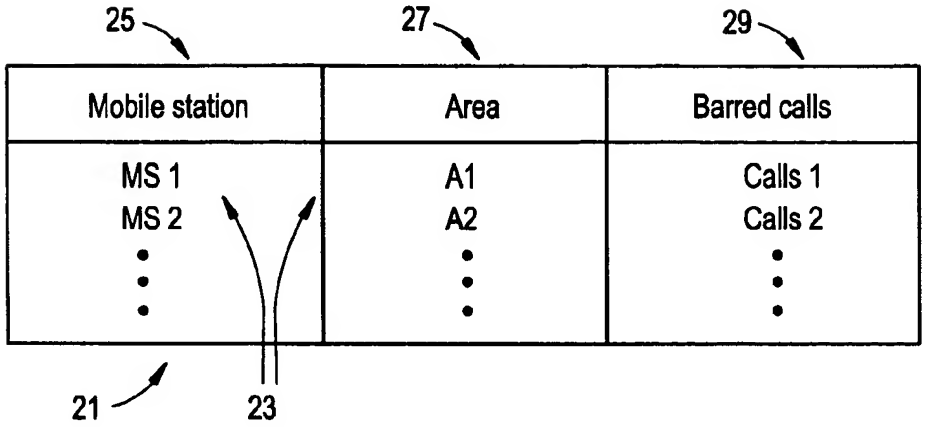


FIG.3

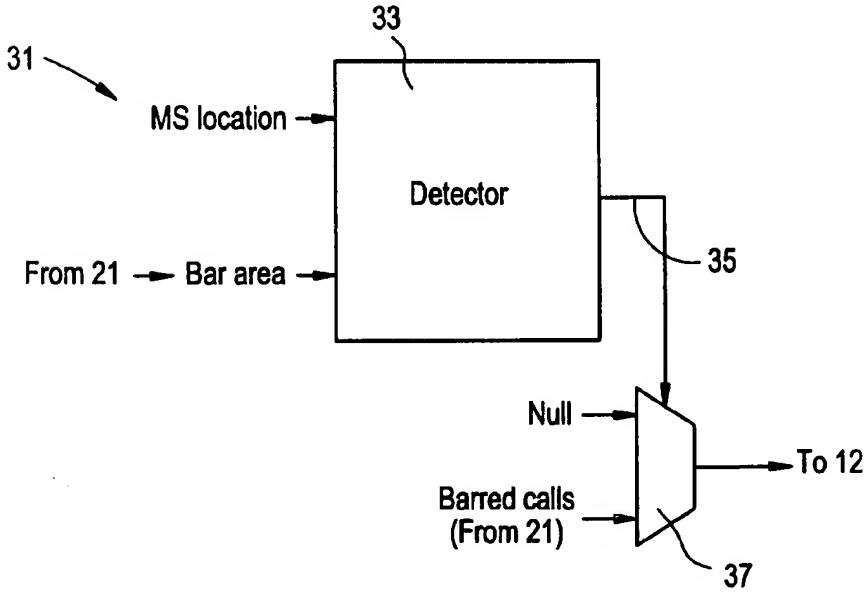


FIG.4

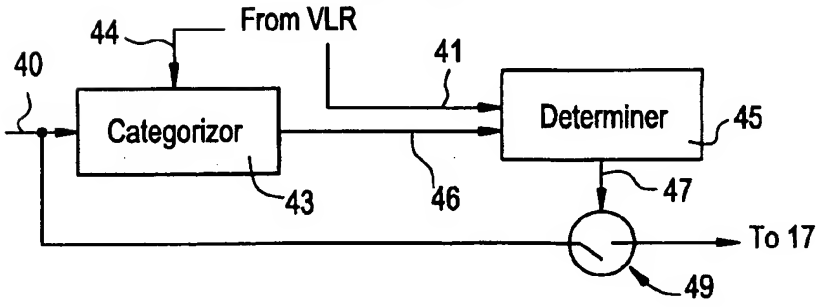


FIG.5

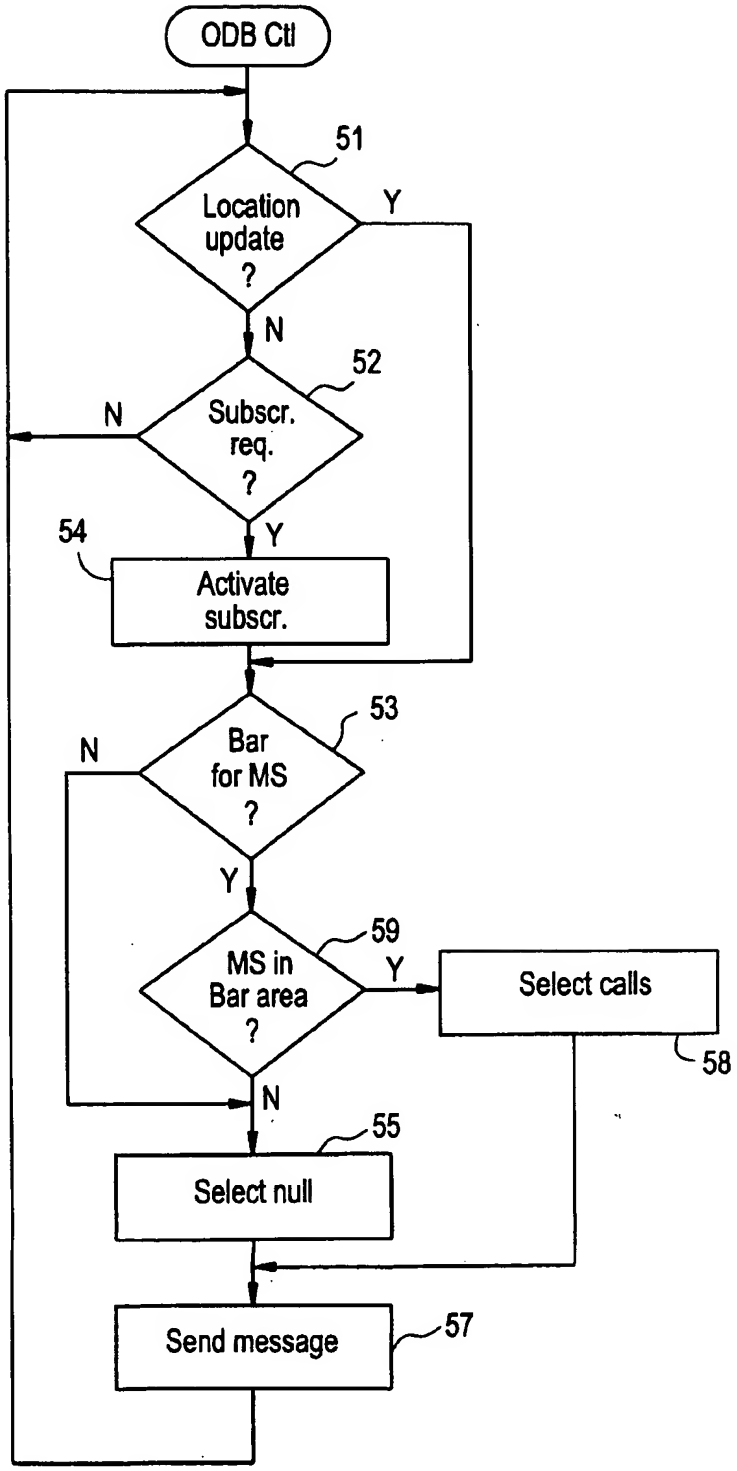

ODB Ctl
51
Location update ?
Y
N
52
Subscr. req. ?
N
Y
54
Activate subscr.
53
Bar for MS ?
N
Y
59
MS in Bar area ?
Y
Select calls
58
N
55
Select null
Send message
57

FIG.6

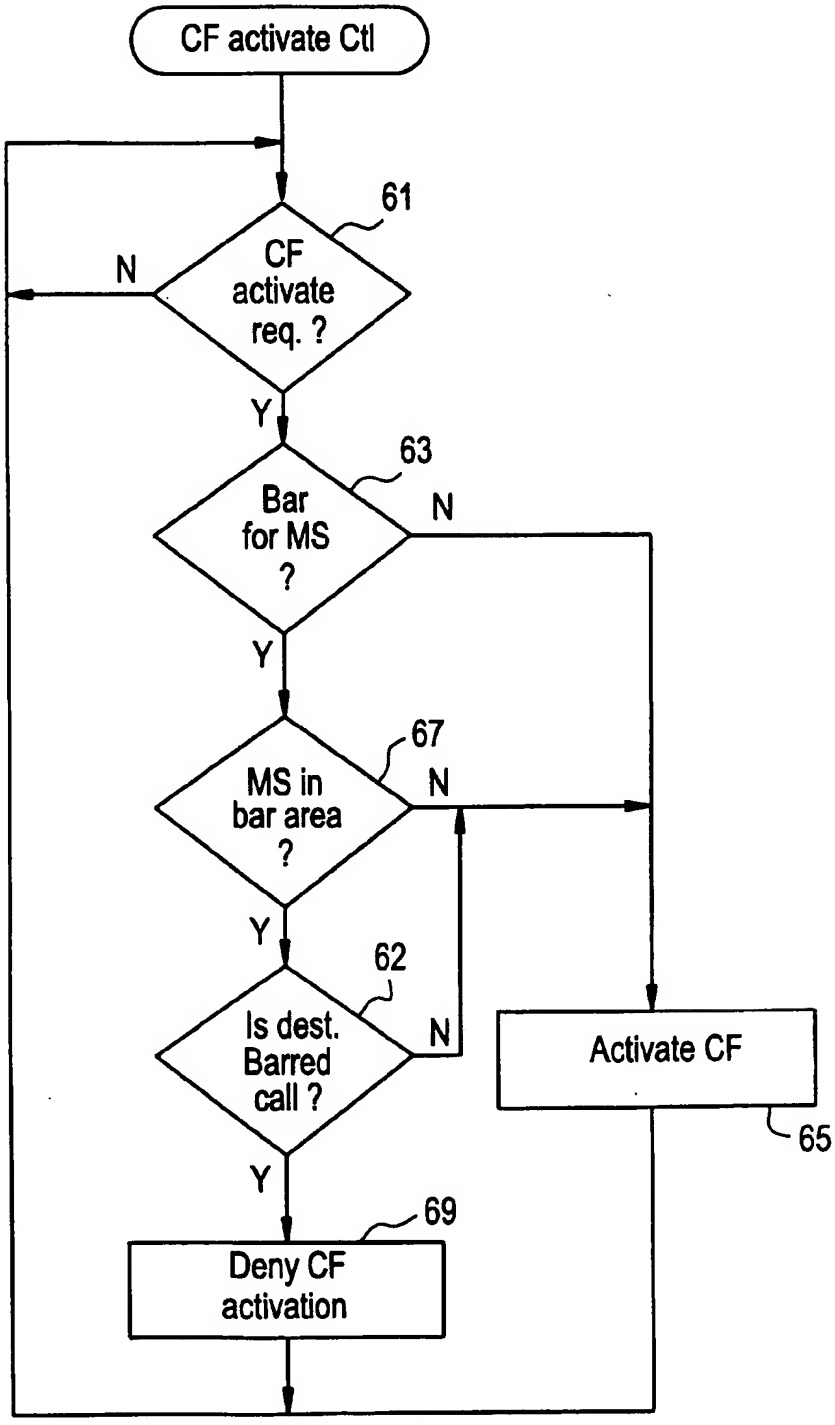

CF activate Ctl
61
CF activate req. ?
N
Y
63
Bar for MS ?
N
Y
67
MS in bar area ?
N
Y
62
Is dest. Barred call ?
N
Y
Activate CF
65
69
Deny CF activation

FIG.7

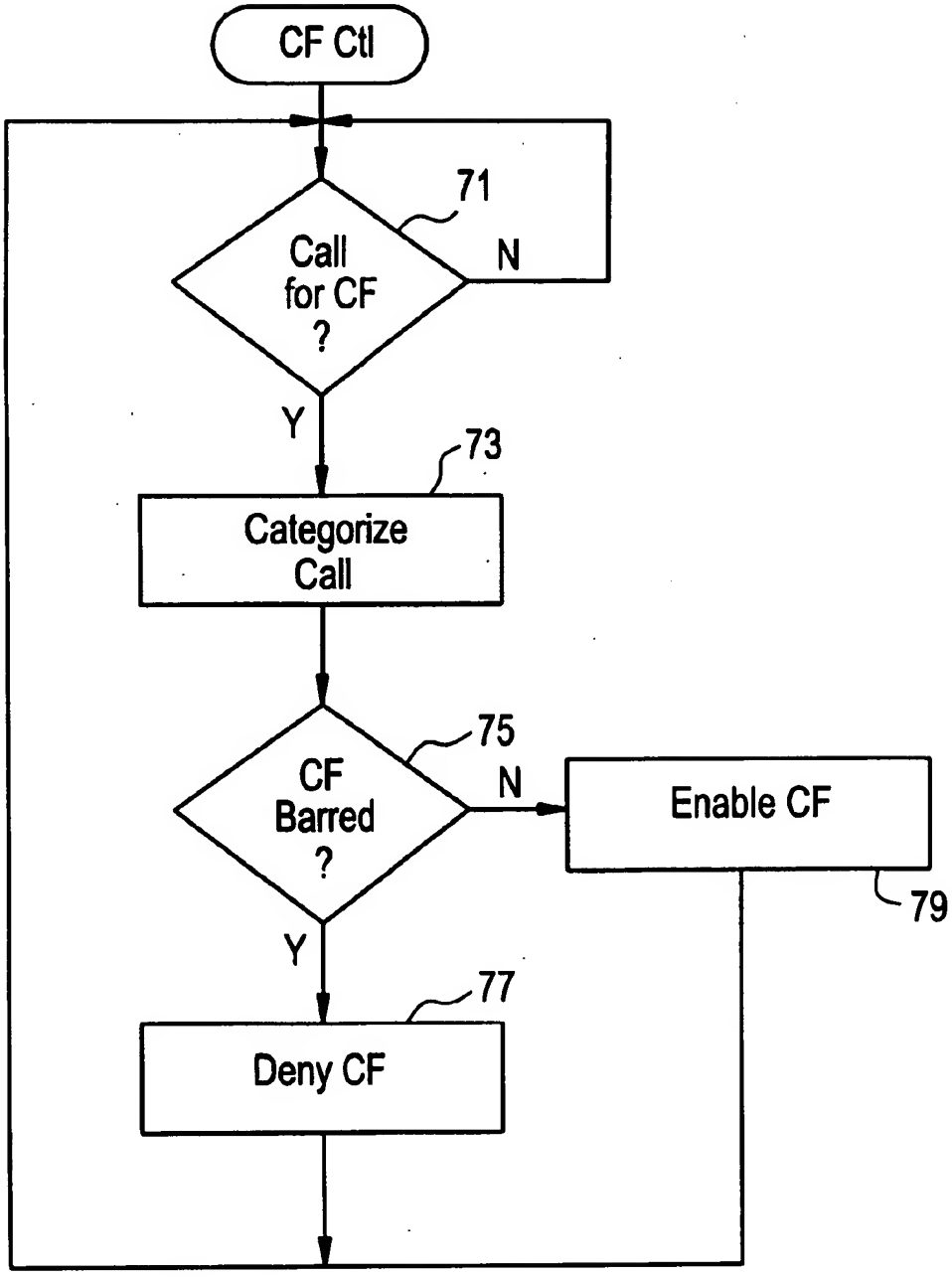

CF Ctl
71
Call for CF ?
N
Y
73
Categorize Call
75
CF Barred ?
N
Enable CF
79
Y
77
Deny CF

FIG.8

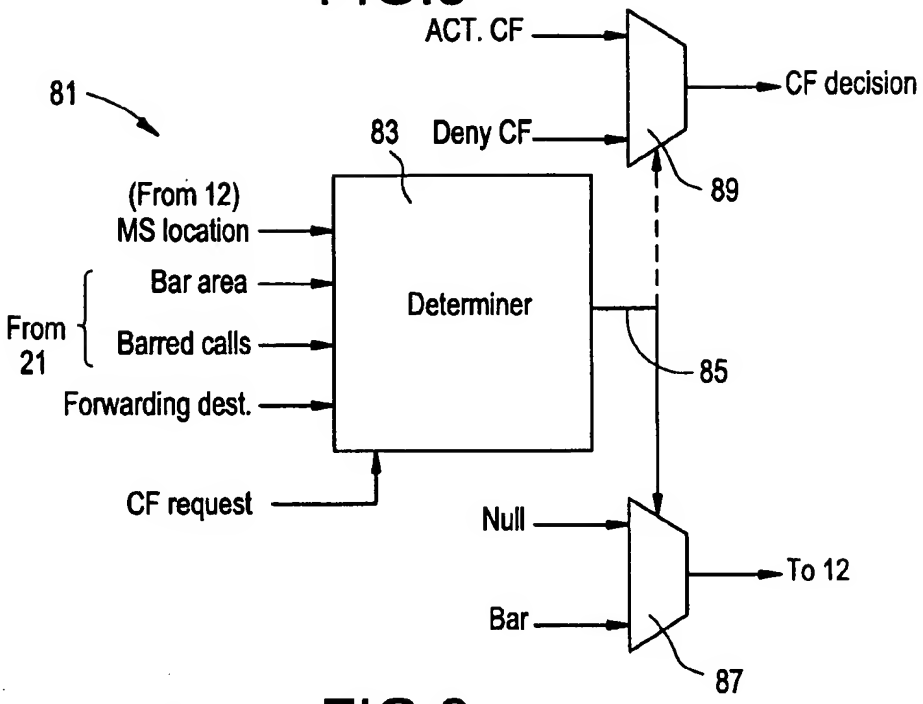
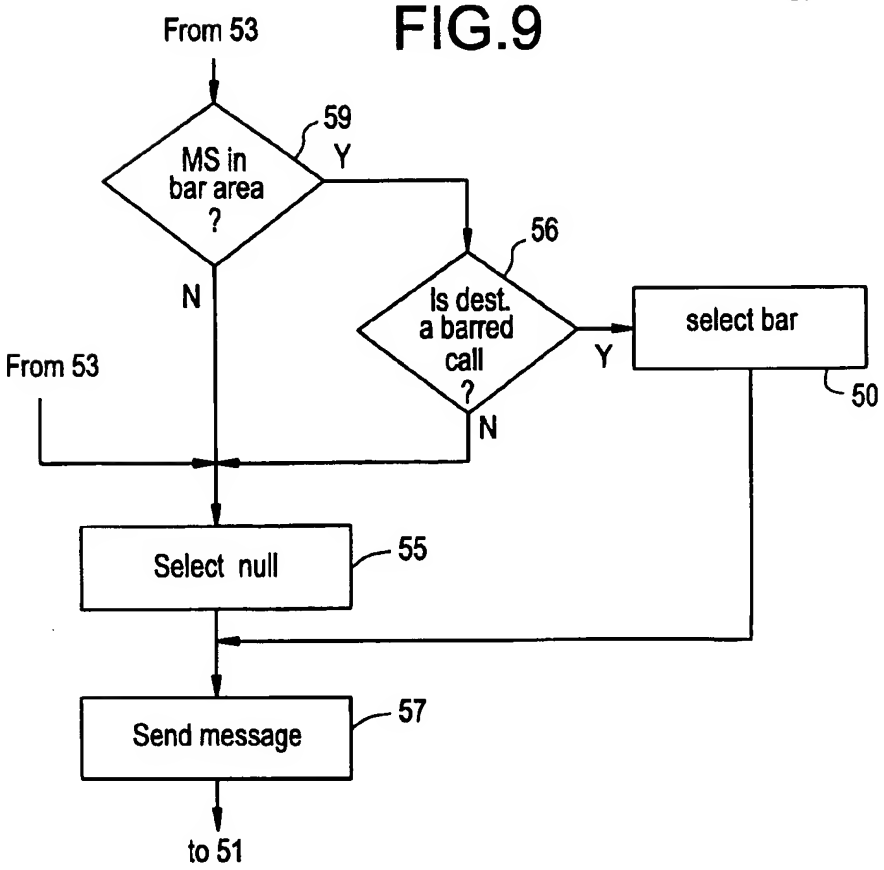

ACT. CF
CF decision
81
83
Deny CF
89
(From 12)
MS location
Bar area
From 21
Barred calls
Forwarding dest.
Determiner
85
CF request
Null
To 12
Bar
87

FIG.9


From 53
59
MS in bar area ?
Y
N
56
Is dest. a barred call ?
Y
N
select bar
50
From 53
Select null
55
Send message
57
to 51

LOCATION TRIGGERED BARRING OF CALL FORWARDING

FIELD OF THE INVENTION

The invention relates generally to wireless mobile communications and, more particularly, to improvements in call forwarding services provided to wireless mobile communication subscribers.

BACKGROUND OF THE INVENTION

In conventional wireless mobile communications, roaming agreements typically exist between network operators of respective public land mobile networks (PLMNs). Such roaming agreements permit a mobile subscriber unit based in a first PLMN to use the services and facilities of a second PLMN while the mobile subscriber unit is roaming in the coverage area of the second PLMN, outside the coverage area of the first PLMN.

Call forwarding (CF) is one example of a service that a roaming mobile subscriber might wish to use while roaming in the second PLMN. Using the conventional GSM (Global System for Mobile communications) network as an example of the first and second PLMNs, in a conventional GSM network the cost of forwarding (or otherwise deflecting) a call is charged to the mobile subscriber which invoked the forwarding. If the mobile subscriber is roaming internationally, then the forwarding of a call will very likely be charged, disadvantageously, as an international call. Paying international call charges to forward a call is typically very expensive.

Call deflecting service is similar to call forwarding, except the mobile subscriber interactively chooses (on a per call basis) to deflect the call to another destination rather than accept the call, whereas call forwarding services are typically handled in the serving mobile switching center (MSC) without interaction of the mobile subscriber. The problems and inventive solutions disclosed herein apply to both call forwarding and call deflecting services.

Another problem with forwarding the calls of the above-described roaming mobile subscriber is fraud. Call forwarding fraud during roaming occurs when the mobile subscriber uses call forwarding service to forward calls received while the mobile subscriber is roaming internationally, but for which the roaming mobile subscriber does not intend to pay the corresponding international charges. Such fraud can be increased by maintaining several simultaneous calls after invocation of the call forwarding service. The same scenario can occur using call diversion service. This fraud problem is very costly for network operators due to the international signaling links and call legs involved during the calls. In fact, fraud is such a large scale problem that network operators in some countries refuse to provide services such as call forwarding services to mobile subscribers roaming in those countries.

In GSM, there are some conventional mechanisms for cost limitation when the mobile subscriber is roaming. For example, an operator determined bar (ODB) can be applied to outgoing calls originating at the mobile subscriber unit, including calls to be forwarded, such that the invocation of call forwarding services is barred. The ODB in GSM also provides for different restriction levels, for example, barring all calls, all international calls, all international calls except those directed to the mobile subscriber's home PLMN country, all inter-zone calls, or all inter-zone calls except those directed to the subscriber's home PLMN country. However, this solution will disadvantageously bar even

outgoing calls for which the mobile subscriber consciously intends to pay the incurred cost.

Another possible solution to the above-described call forwarding problems is simply for the mobile subscriber to deactivate the call forwarding services. However, the subscriber may well forget to deactivate the services when roaming internationally. Moreover, deactivation of call forwarding does not address the fraud problem described above.

Call forwarding can be barred using conventional Regional Services functionality, but only by disadvantageously deregistering the mobile station from all services to which it subscribes whenever that mobile station enters the service area of a disallowed MSC. Moreover, this type of service must be implemented in the MSC/VLR and can only be used if the Regional Services functionality is implemented in the PLMN where the subscriber is roaming.

Another possible approach would be to use Intelligent Network (IN) architecture to implement services aimed at solving the above-described problems. However, disadvantageously, the Intelligent Network support must be requested in the PLMN where the subscriber is roaming.

It is therefore desirable to provide to a roaming mobile subscriber call forwarding (or deflecting) service with automatically activated security against large, unwanted charges for forwarding/deflecting calls without barring all of the mobile subscriber's outgoing calls.

The present invention provides for selective barring of call forwarding/deflecting services. The selective barring is triggered by the location of the mobile subscriber unit, thereby avoiding the occurrence of many unwanted call forwarding/deflecting charges when the mobile subscriber unit is roaming, and all outgoing calls need not be barred.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates two inter-networked PLMNs including a call forward barring feature according to the invention.

FIG. **2** illustrates an example of a memory and database in the HLR of FIG. **1**.

FIG. **3** illustrates one example portion of the HLR of FIG. **1** in greater detail.

FIG. **4** illustrates an example portion of the MSC/VLR of FIG. **1** in greater detail.

FIG. **5** illustrates exemplary operations of the HLR portion of FIG. **3**.

FIG. **6** illustrates exemplary operations of the HLR portion of FIG. **8**.

FIG. **7** illustrates exemplary operations of the MSC/VLR portion of FIG. **4**.

FIG. **8** illustrates another example portion of the HLR of FIG. **1** according to another embodiment of the invention.

FIG. **9** illustrates exemplary operations of the HLR portion of FIG. **8**.

DETAILED DESCRIPTION

FIG. **1** illustrates an example of an inter-networking mobile communications arrangement that implements the present invention. In FIG. **1**, a mobile subscriber unit MS_H has roamed from the coverage area of its home PLMN, designated in FIG. **1** as HPLMN, into the coverage area of a visited PLMN, designated in FIG. **1** as VPLMN. Conventional examples of the HPLMN and VPLMN of FIG. **1** include GSM, DCS **1800** (Digital Cellular System for Mobile Communications), and PCS (Personal Communica-

tions System). The HPLMN and VPLMN of FIG. 1 can be defined, for example, by any of the foregoing conventional network standards, such conventional networks of course being enhanced as disclosed herein to include the present invention.

Although only pertinent portions of HPLMN and VPLMN are illustrated in FIG. 1 for clarity of exposition, it will be recognized that HPLMN and VPLMN of FIG. 1 represent fully functional PLMNs. For example, the VPLMN includes a home location register HLR (or a suitable equivalent) similar to that shown in the HPLMN, and the HPLMN includes a mobile services switching center and visited location register (collectively designated as MSC/VLR in FIG. 1) similar to that illustrated in the VPLMN. One example of an equivalent alternative to the MSC/VLR of FIG. 1 is an SGSN (Serving GPRS Support Node). As mentioned above, with the exception of the herein described enhancements according to the present invention, the HPLMN and VPLMN of FIG. 1 can be, and for purposes of this description are assumed to be, otherwise conventional.

Mobile subscriber MS_H is shown in broken lines in HPLMN to indicate that it has roamed out of HPLMN and into VPLMN where MS_H is shown to be visiting. Other mobile subscriber units MS are shown in both the HPLMN and the VPLMN. Although the present invention is described with respect to the mobile subscriber unit MS_H, the principles of the invention are equally applicable to any of the mobile subscriber units MS when they roam, for example, outside of their home PLMN.

When MS_H roams into VPLMN, it checks in with MSC/VLR (as is conventional), which requests a Location Update from the HLR of HPLMN using the MAP communications link illustrated diagrammatically at 12 in FIG. 1. MAP refers to conventional Mobile Application Part signaling. This MAP "Location Update" operation is well-known in the art, and provides to HLR current location information regarding MS_H, along with other conventional information. In response to the MAP "Location Update" request, the HLR conventionally responds with a MAP "Insert Subscriber Data" message signaled, for example, over the MAP link 12. According to the invention, the HLR also provides, in the "Insert Subscriber Data" message, information relative to call forwarding/deflecting services, for example, whether or not call forwarding services subscribed to by MS_H are to be barred. The MSC/VLR of VPLMN uses this bar information from HLR to decide whether or not to permit calls for MS_H to be forwarded (or deflected) to another destination, for example at 15, via a communications path 17. The destination 15 could also be located elsewhere, e.g. in another PLMN outside both PLMNs of FIG. 1, or in a Public Switched Telephone Network (PSTN) as shown by broken lines.

FIG. 2 illustrates one example of a memory 21 in the HLR of FIG. 1. The memory 21 has stored therein a database 23 as shown. The database 23 includes information about operator determined barring (ODB) services to which various mobile subscribers have subscribed. Column 25 illustrates the mobile subscriber units (also referred to as mobile stations) MS1, MS2, etc. which have subscribed to ODB services. Column 27 illustrates the areas (designated A1, A2, etc. in which the subscribed ODBs are effective, and column 29 illustrates the calls which are barred (designated as Calls1, Calls2, etc.) when the respective mobile stations are located in the respective areas A1, A2, etc. of column 27.

Examples of the effective areas A1, A2, etc. in column 27 of FIG. 2 include: outside of the mobile subscriber's HPLMN coverage area; outside of the mobile subscriber's HPLMN country; and outside of the mobile subscriber's HPLMN zone. Examples of the barred calls represented by Calls1, Calls2, etc. in column 29 of FIG. 2 include: all forwarding calls; all international forwarding calls; all international forwarding calls except those directed to the subscriber's HPLMN country; all inter-zone forwarding calls; and all inter-zone forwarding calls except those directed to the subscriber's HPLMN country. These examples of effective areas and categories of forwarding (or deflecting) calls can be seen to yield, in this example, 15 distinct subscriptions available to the mobile subscribers. More specifically, for each of the aforementioned three effective areas, there are five different categories of calls which can be barred. Of course, the number and definition of effective ODB areas and the number and definition of barred calls categories can be set up as needed by the network operator in order to obtain the ODB functionality that is desired.

FIG. 3 illustrates an example portion 31 of the HLR of FIG. 1. The portion 31 may be used to implement the ODB services defined in FIG. 2. In FIG. 3, a detector 33 receives as inputs the location of the mobile subscriber and the effective bar area, and provides an output signal 35 indicative of whether or not the Mobile subscriber is located in the corresponding bar area. For example, and referring also to FIG. 2, the output signal 35 from the detector 33 would indicate whether or not the mobile station MS1 is within the bar area A1. If MS1 is located in area A1, then the output signal 35 will control multiplexer 37 such that the barred calls input of multiplexer 37 is coupled to the output of multiplexer 37. In this example, the barred calls input of multiplexer 37 would be the barred calls definition represented by Calls1 in column 29 of the database 23 in FIG. 2. If MS1 is not located in area A1, then signal 35 will couple the Null input of multiplexer 37 to the output of multiplexer 37. The Null input indicates that no ODB is to be implemented. The output of multiplexer 37 is provided to VLR (see FIG. 1) as part the MAP "Insert Subscriber Data" message sent over MAP link 12.

FIG. 4 illustrates example portions of MSC/VLR in the VPLMN of FIG. 1. When at 40 the MSC receives a call for MS_H that is to be forwarded (or receives from MSH a call to be deflected), the call to be forwarded is input to a categorizor 43, which examines and categorizes the call that is to be forwarded. Then, a determiner 45 receives from categorizor 43 a signal 46 indicative of the category of the call. The determiner also receives from VLR an input 41 indicative of any forwarding calls which are barred and thus will not be forwarded from the mobile subscriber unit MS_H. If the determiner 45 determines that the call category as output from categorizor 43 corresponds to the information from VLR regarding the category of calls to be barred, then the output signal 47 from determiner 45 maintains switch 49 in the open position, so that the call is not forwarded to the destination (e.g. 15 of FIG. 1). However, if the determiner 45 determines that the category of the call to be forwarded does not fall within the barred call category information received from VLR, then the output 47 of determiner 45 closes switch 49 to permit the call to be forwarded from the MSC to the destination 15 via the communication path 17 of FIG. 1.

For example, if the output 46 of categorizor 43 indicates that the call at 40 is an international forwarding call directed to the mobile subscriber's HPLMN country, and if the barred call category information 41 from VLR indicates that all international forwarding calls except those directed to the mobile subscriber's HPLMN country are to be barred, then the determiner 45 will close the switch 49 to permit for-

warding of the call. On the other hand, using the same call to be forwarded and thus the same output **46** from the categorizor **43**, but assuming that the information **41** from VLR indicates that all international forwarding calls are barred, then the determiner **43** will maintain the switch **49** open to prevent the call from being forwarded. Information about the HPLMN and HPLMN country of MS_H is provided by VLR to categorizor **43** at input **44**. VLR receives the HPLMN and HPLMN country information from HLR in the MAP "Insert Subscriber Data" message.

FIG. **5** illustrates an example of the ODB control operations implemented by the example HLR portion of FIG. **3**. In FIG. **5**, it is first determined at **51** whether a MAP "Location Update" message has been received from an MSC/VLR, for example in the VPLMN of FIG. **1**. If so, it is then determined at **53** whether or not the mobile subscriber associated with the Location Update message has subscribed to an ODB. If not, then the database **23** of FIG. **2** will yield a null value to be applied to the bar area input of detector **33** in FIG. **3**. (For example, if the mobile subscriber has not subscribed to an ODB, then that mobile subscriber would not have a corresponding entry in the database **23**, resulting in the null input to detector **33**). This null value at the bar area input of detector **33** will cause the detector output **35** to select the null value at multiplexer **37**, which step is illustrated at **55** in FIG. **5**. Thereafter, at **57** the HLR sends a MAP Insert Subscriber Data message to the MSC/VLR via the MAP signaling link of FIG. **1**. Information from this Insert Subscriber Data message, including the null value from multiplexer **37**, will be stored in the VLR, and the null value will be provided at **41** to the determiner **45** (see FIG. **4**). This null value indicates to the determiner that no ODBs are in effect for the mobile subscriber, so that all calls can be forwarded (or deflected) through the switch **49**, regardless of the output **46** from the categorizor.

If at **53** the HLR determines that the mobile subscriber does subscribe to an ODB, then at **59** the detector **33** of FIG. **3** determines whether or not the mobile subscriber is located in an effective bar area. The MS location input to the detector **33** is of course received in the MAP "Location Update" message (see **51**). If at **59** the detector **33** determines that the mobile subscriber is not located in the bar area, then the null value is selected at **55** to be output from the multiplexer **37** of FIG. **3**, as described above. If at **59** the detector **33** determines that the mobile subscriber is located in the associated bar area, then at **58** the control signal **35** of FIG. **3** causes the multiplexer **37** to select the barred calls information. Thereafter, the Insert Subscriber Data message is sent over the MAP link (see FIG. **1**), and the barred calls information is stored in the VLR of the VPLMN.

In FIG. **5** if no "Location Update" message is received at **51**, it is determined at **52** whether an ODB subscription request has been received. Such a subscription request is typically done by the operator using the conventional operation and maintenance system. If so, then the ODB subscription is activated at **54**, for example, by inserting into the database **23** of FIG. **2** an entry identifying the mobile station, the bar area and the barred calls. Thereafter, the same steps (**53**, **55**, **57**, **58** and **59**) are executed as described above with respect to the receipt of a "Location Update" message at **51**. Thus, when a mobile subscriber that already subscribes to call forwarding (or deflecting) requests an ODB subscription at **52**, if that mobile subscriber is in the bar area corresponding to the ODB being subscribed to (see **59**), then the barred calls information from the database of FIG. **2** will be transmitted in an Insert Subscriber Data message to the MSC/VLR currently visited by that mobile subscriber (see **57** and **58**).

FIG. **8** illustrates another example portion **81** of the HLR of FIG. **1** according to another embodiment of the invention. The portion **81** implements the ODB functionality of the present invention without requiring any modifications to the conventional MSC/VLR design. Because the mobile station's call forwarding subscription is conventionally recorded in HLR, the forwarding destination number is already conventionally stored in HLR. Thus, the determiner **83** of FIG. **8** examines the mobile station location information (from the "Location Update" request), the bar area information (from FIG. **2**), the barred calls information (from FIG. **2**), and the known forwarding destination information, and determines therefrom whether the mobile station is in a barred area and whether a forwarding call to the forwarding destination falls in the barred calls category. The determiner output **85** then selects at multiplexer **87** either a null message or a bar message to be sent to MSC/VLR in the "Insert Subscriber Data" message. Information about whether or not to inhibit call forwarding is conventionally included in the "Insert Subscriber Data" message, for example, the so-called active quiescent state in GSM, so the ODB of the invention can be implemented by suitably communicating the conventional active-quiescent state to a conventional MSC/VLR design.

The example portion **81** of HLR illustrated in FIG. **8** can alternatively be used to approve or deny a request to activate call forwarding services for a mobile subscriber that already subscribes to the ODB services of the invention. For example, if the HLR of FIG. **1** receives a request (see CF request in FIG. **8**) from a mobile station (that already subscribes to the ODB service) to activate call forwarding services for that mobile Stall on, then determiner **83** will determine whether or not the mobile station, for example MS**1** of FIG. **2**, is in its associated bar area, in this example, area A**1**, and whether or not the barred calls category, in this example Calls**1**, includes a call to the forwarding destination. If the mobile station is in area A**1** (the location of the mobile station is known from the most recent Location Update Message) and the Calls**1** category includes calls to the forwarding destination, then the determiner output **85** will control multiplexer **89** (via the broken lines shown in FIG. **8**) such that the deny CF input of multiplexer **89** is coupled to the output thereof. Thus, the HLR determines that call forwarding should not be activated for a mobile station which is currently located in an effective bar area according to its own ODB subscription, and whose selected forwarding destination falls within the effective barred calls category of its own ODB subscription. On the other hand, if the determiner **83** does not detect that mobile station MS**1** is in area A**1**, or does not determine that a call to the forwarding destination falls in the Calls**1** category, the determiner output **85** controls multiplexer **89** such that the activate call forwarding (ACT.CF) input of multiplexer **89** is coupled to the output thereof. In this manner, the HLR makes the decision of whether or not to activate call forwarding services for the particular mobile subscriber.

FIG. **9** illustrates example operations of the HLR portion **81** of FIG. **8**. FIG. **9** is the same as the example of FIG. **5** up to decision block **59**. At block **59**, if the MS is in the bar area, it is then determined at **56** whether a call to the forwarding destination is in the barred calls category. If so, then the bar message is selected at **50** (see **87** in FIG. **8**), and, if not, then the null message is selected at **55** (see **87** in FIG. **8**). After the message is selected at **50** or **55**, the message is sent at **57** as in FIG. **5**.

FIG. **6** illustrates an example of the operation of the HLR portion of FIG. **8** to control activation of call forwarding (or

deflecting) services. At **61**, once a request to activate call forwarding is received, it is next determined at **63** whether the requesting mobile subscriber currently subscribes to an ODB. If not, the call forwarding services are activated conventionally at **65**, after which the next request to activate call forwarding is awaited at **61**. If it is determined at **63** that the requesting mobile subscriber does subscribe to an ODB, it is then determined at **67** whether or not the mobile subscriber is in the bar area associated with the ODB subscription. If not, then the call forwarding services are activated at **65** as above (see **89** of FIG. **8**). If the requesting mobile subscriber is in the bar area associated with its own ODB subscription, it is then determined at **62** whether a call to the forwarding destination falls in the barred calls category. If so, then activation of call forwarding services is denied at **69** (see **89** of FIG. **8**). If a call to the destination number does not represent a barred call at **62**, then call forwarding is activated at **65**. Thereafter, the next request for activation of call forwarding is awaited at **61**.

FIG. **7** illustrates an example of call forwarding (or deflecting) control operations performed by the MSC/VLR portion shown in FIG. **4**. It is first determined at **71** whether the MSC has received a call to be forwarded. If so, then at **73** the categorizor of FIG. **4** categorizes the call, and at **75** the determiner of FIG. **4** determines whether or not call forwarding is barred for that particular call. If call forwarding is barred, then the call forwarding is denied at **77** by leaving the switch of FIG. **4** in the open position. If call forwarding is not barred at **75**, then at **79** call forwarding is enabled by closing the switch of FIG. **4**. During call forwarding operation, the switch **49** of FIG. **4** remains closed until the forwarded call has been completed, whereupon the switch is reopened and remains so until call forwarding is next enabled. This control of the switch prevents any calls from being forwarded until it is adequately determined that no ODB is applicable to the candidate for forwarding. After the decision to enable or deny call forwarding has been made and the appropriate action taken at **75**, **77**, and **79**, the next candidate for call forwarding is awaited at **71**.

By using the location of the mobile subscriber as a trigger to bar call forwarding (or deflecting) without barring all outgoing calls, call forwarding costs for roaming subscribers can be controlled, and fraud can be avoided, without restricting all outgoing calls, or all international calls, and without unconditionally barring call forwarding. The location-triggered ODB can be advantageously implemented by suitably modifying one or more of the conventional HLR, VLR and MSC nodes as needed and, further advantageously, the conventional MAP signaling protocol can be used.

It will be clear to workers in the art that the embodiments of FIGS. **1–9** can be readily implemented, for example, in hardware, or software, or suitable combinations of hardware and software in a conventional HLR, a conventional MSC, and a conventional VLR.

Although exemplary embodiments of the present invention have been described above in detail, this does not limit the scope of the invention, which can be practiced in a variety of embodiments.

What is claimed is:

1. An apparatus for controlling call forwarding service provided to a wireless mobile communication station, comprising:

an input for receiving information indicative of a location of the wireless mobile communication station and for receiving information indicative of a call forwarding bar area, and

a determiner coupled to said input, said determiner having an output responsive to said location information and said call forwarding bar area information for indicating that call forwarding from the wireless mobile communication station is barred, without indicating that other outgoing calls from the wireless mobile communication station are barred.

2. The apparatus of claim **1**, wherein said call forwarding bar area is located outside of a coverage area associated with a home mobile communication network of the wireless mobile communication station.

3. The apparatus of claim **1**, wherein said call forwarding bar area is located outside of a country in which is located a coverage area associated with a home mobile communication network of the wireless mobile communication station.

4. The apparatus of claim **1**, wherein said call forwarding bar area is located outside of a zone in which is included a coverage area associated with a home mobile communication network of the wireless mobile communication station.

5. The apparatus of claim **1**, wherein said input is further for receiving call identification information that identifies forwarding calls to be barred, and wherein said output is further responsive to said call identification information for indicating that call forwarding from the wireless mobile communication station is barred.

6. The apparatus of claim **5**, including a memory coupled to said input and having stored therein an entry that includes said call forwarding bar area information.

7. The apparatus of claim **6**, wherein said entry includes station identification information that identifies the wireless mobile communication station.

8. The apparatus of claim **7**, wherein said entry includes said call identification information.

9. The apparatus of claim **5**, including a memory coupled to said input and having stored therein an entry which includes said call identification information.

10. The apparatus of claim **9**, wherein said entry indicates that all forwarding calls are to be barred.

11. The apparatus of claim **9**, wherein said entry indicates that all international forwarding calls are to be barred.

12. The apparatus of claim **9**, wherein said entry indicates that all inter-zone forwarding calls are to be barred.

13. The apparatus of claim **1**, wherein said determiner is operable for indicating that call forwarding from the wireless mobile communication station to a forwarding destination is barred, without indicating that all other types of outgoing calls from the wireless mobile communication station to said forwarding destination are barred.

14. The apparatus of claim **1**, wherein said input is further for receiving information indicative of an area into which call forwarding from the wireless mobile communication station is prohibited when the wireless mobile communication station is located in the call forwarding bar area, said determiner operable in response to said prohibited area information and said call forwarding bar area information and said location information for indicating that call forwarding from the wireless mobile communication station is barred.

15. An apparatus for controlling call forwarding service provided to a wireless mobile communication station, comprising:

an input for receiving information indicative of a location of the wireless mobile communication station; and

an output for indicating, based on the location information, that call forwarding from the wireless mobile communication station to a forwarding desti-

nation is barred, without indicating that all other types of outgoing calls from the wireless mobile communication station to the forwarding destination are barred.

16. A method of controlling call forwarding service provided to a wireless mobile communication station, comprising:

receiving information indicative of a location of the wireless mobile communication station;

receiving information indicative of a call forwarding bar area; and

indicating, based on the location information and the call forwarding bar area information, that call forwarding from the wireless mobile communication station is barred, without indicating that other outgoing calls from the wireless mobile communication station are barred.

17. The method of claim 16, wherein said call forwarding bar area is located outside of a coverage area associated with a home mobile communication network of the wireless mobile communication station.

18. The method of claim 16, wherein the call forwarding bar area is located outside of a country in which is located a coverage area associated with a home mobile communication network of the wireless mobile communication station.

19. The method of claim 16, wherein the call forwarding bar area is located outside of a zone in which is included a coverage area associated with a home mobile communication network of the wireless mobile communication station.

20. The method of claim 16, wherein said indicating step includes determining from the location information and the call forwarding bar area information whether the wireless mobile communication station is located in the call forwarding bar area.

21. The method of claim 20, wherein said indicating step includes indicating that call forwarding is barred when (1) the wireless mobile communication station is determined to be located in the call forwarding bar area and (2) a call forwarding destination associated with the mobile station requires a forwarding call that is included in a predetermined category of calls barred to the mobile station while the mobile station is in the call forwarding bar area.

22. The method of claim 16, including identifying forwarding calls which are to be barred.

23. The method of claim 22, wherein said identifying step includes indicating that all forwarding calls are to be barred.

24. The method of claim 22, wherein said identifying step includes identifying all international forwarding calls to be barred.

25. The method of claim 22, wherein said identifying step includes identifying all inter-zone forwarding calls to be barred.

26. The method of claim 16, wherein said indicating step includes indicating that call forwarding from the wireless mobile communication station to a forwarding destination is barred, without indicating that all other types of outgoing calls from the wireless mobile communication station to said forwarding destination are barred.

27. The method of claim 16, including receiving information indicative of an area into which call forwarding from the wireless mobile communication station is prohibited when the wireless mobile communication station is located in the call forwarding bar area, said indicating step including indicating, based on the location information and the call forwarding bar area information and the prohibited area information, that call forwarding from the wireless mobile communication station is barred.

28. A method of controlling call deflecting service provided to a wireless mobile communication station, comprising:

receiving information indicative of a location of the wireless mobile communication station;

receiving information indicative of a call deflecting bar area; and

indicating, based on the location information and the call deflecting bar area information, that call deflecting from the wireless mobile communication station is barred, without indicating that other outgoing calls from the wireless mobile communication station are barred.

29. The method of claim 28, wherein said indicating step includes indicating that call deflecting from the wireless mobile communication station to a deflecting destination is barred, without indicating that all other types of outgoing calls from the wireless mobile communication station to said deflecting destination are barred.

30. The method of claim 28, including receiving information indicative of an area into which call deflecting from the wireless mobile communication station is prohibited when the wireless mobile communication station is located in the call deflecting bar area, said indicating step including indicating, based on the location information and the call deflecting bar information and the prohibited area information, that call deflecting from the wireless mobile communication station is barred.

31. An apparatus for controlling call forwarding service provided to a mobile station, without modifying mobile switching center/visitor location register design, comprising:

an input for receiving information indicative of a location of the mobile station sent from a mobile switching center/visitor location register;

a storage portion for storing therein call forwarding destination information, call forwarding bar area information and barred forwarding calls information associated with the mobile station; and

a determiner coupled to said input and said storage apparatus, said determiner having an output responsive to said location information and said call forwarding bar area information and said barred forwarding calls information and said call forwarding destination information for indicating to said mobile switching center/visitor location register that call forwarding from said mobile station is barred, without indicating that other outgoing calls from said mobile station are barred.

32. The apparatus of claim 31, provided in a home location register (HLR).

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(54) **SYSTEM AND METHOD FOR PROVIDING RESTRICTING POSITIONING OF A TARGET MOBILE STATION BASED ON THE CALCULATED LOCATION ESTIMATE**

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(52) **U.S. Cl.** **455/456**; 455/411; 455/421
(58) **Field of Search** 342/457; 455/456, 455/422, 428, 433–435, 457, 461, 421, 560, 561, 466; 340/989, 434

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,442,805	A *	8/1995	Sagers et al.	455/456
5,682,142	A *	10/1997	Loosmore et al.	340/572
5,727,057	A *	3/1998	Emery et al.	379/211
5,768,686	A *	6/1998	LeBlanc et al.	455/456
5,940,764	A *	8/1999	Mikami	455/456
5,950,125	A *	9/1999	Buhrmann et al.	455/422
5,960,341	A *	9/1999	LeBlanc et al.	455/426
6,011,973	A *	1/2000	Valentine et al.	455/456
6,023,624	A *	2/2000	Hanson	455/458
6,101,387	A *	8/2000	Granberg et al.	455/433
6,104,931	A *	8/2000	Havinis et al.	455/456
6,134,447	A *	10/2000	Havinis et al.	455/456
6,138,003	A *	10/2000	Kingdon et al.	455/410
6,167,266	A *	12/2000	Havinis et al.	455/433
6,181,934	B1 *	1/2001	Havinis et al.	455/432
6,195,557	B1 *	2/2001	Havinis et al.	455/456
6,212,390	B1 *	4/2001	Rune	455/456
6,249,808	B1 *	6/2001	Seshadri	709/206
6,256,064	B1 *	6/2001	Monroe	455/66
6,272,342	B1 *	8/2001	Havinis et al.	455/433
6,295,454	B1 *	9/2001	Havinis et al.	455/456
6,347,228	B1 *	2/2002	Ludden et al.	455/456

* cited by examiner

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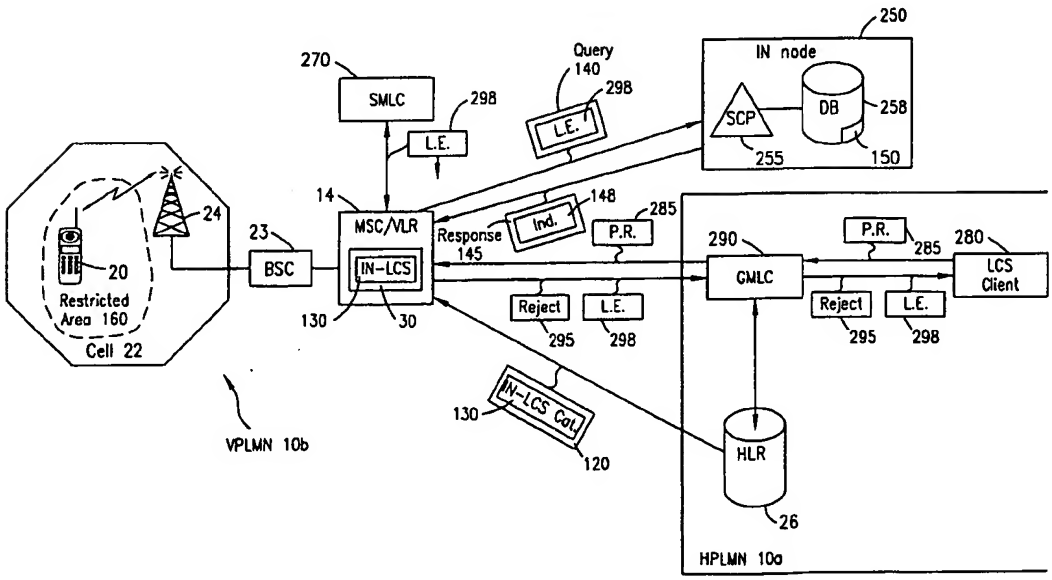
(57) **ABSTRACT**

A telecommunications system and method is disclosed for defining restricted positioning areas by geographical location. The restricted area information can be established by the cellular network or the mobile subscriber, and can be stored in a database, such as an Intelligent Network (IN) node. An IN trigger can be included in the subscriber information provided to the serving Mobile Switching Center/Visitor Location Register (MSC/VLR) or the IN trigger can be stored in specific MSC/VLR's that have restricted positioning areas for all mobile subscribers. Upon receiving the calculated location estimate, the IN trigger is activated, and the MSC/VLR transmits the calculated location estimate to the IN node to determine whether the calculated location estimate can be provided to the requesting Location Services (LCS) client based upon the defined restricted positioning area information.

30 Claims, 5 Drawing Sheets



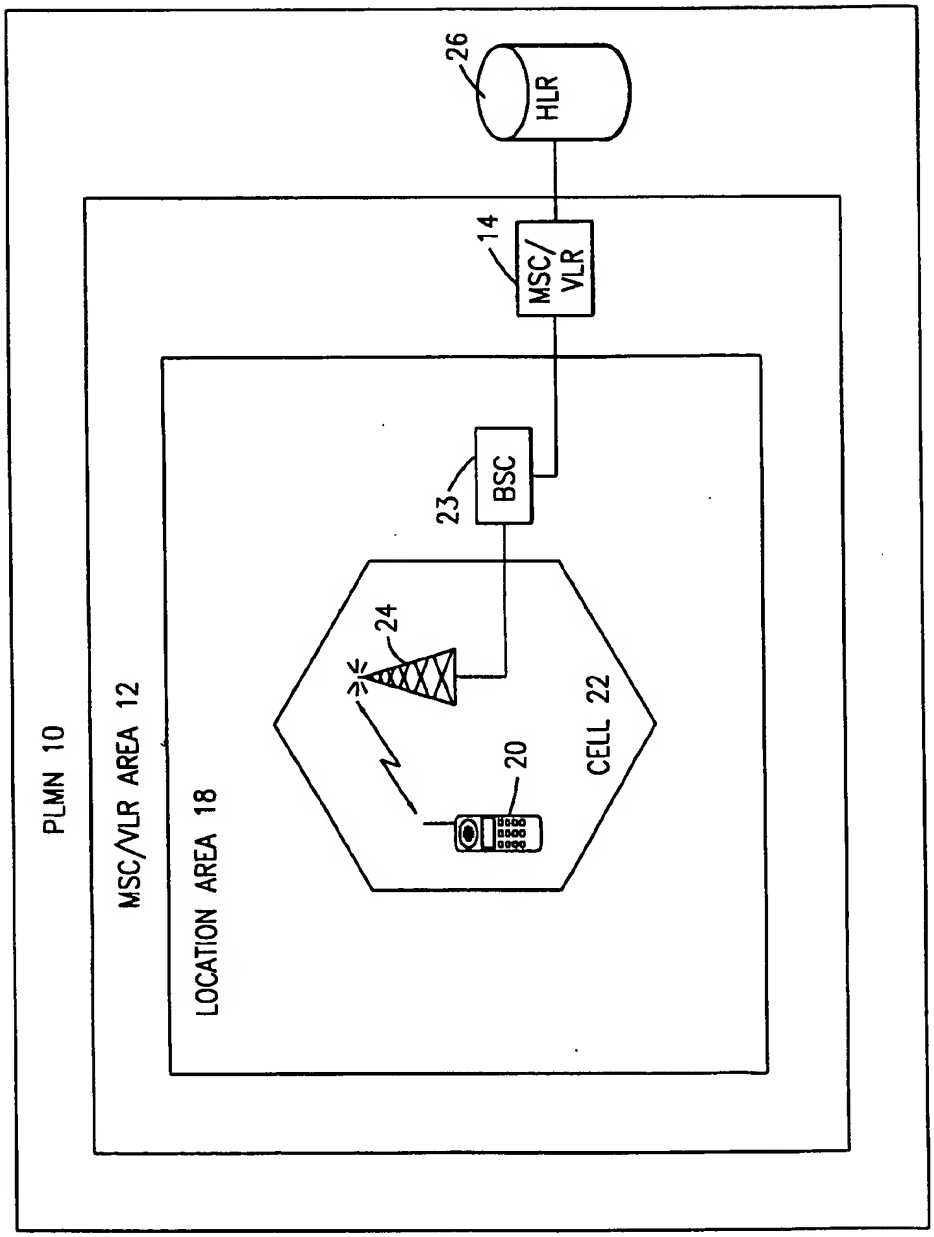

26
HLR
14
MSC/
VLR
BSC
23
24
20
CELL 22
LOCATION AREA 18
MSC/VLR AREA 12
PLMN 10

FIG. 1

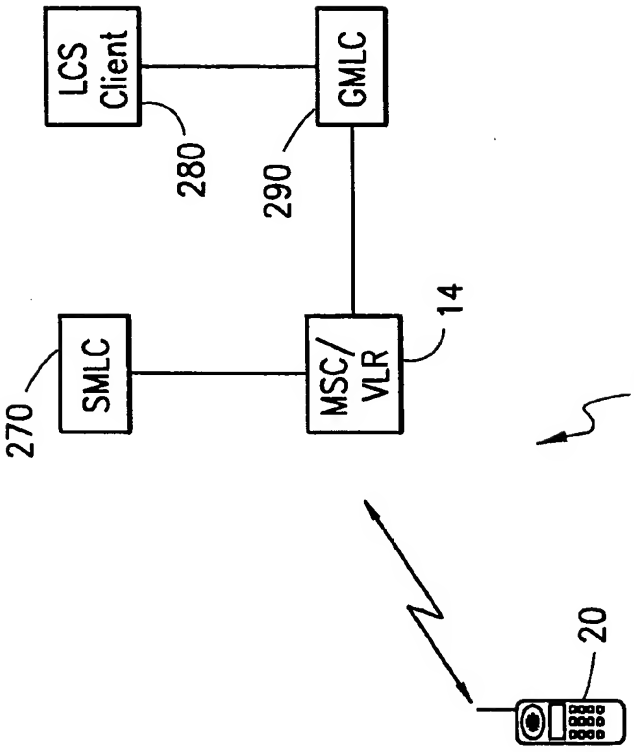


FIG. 2

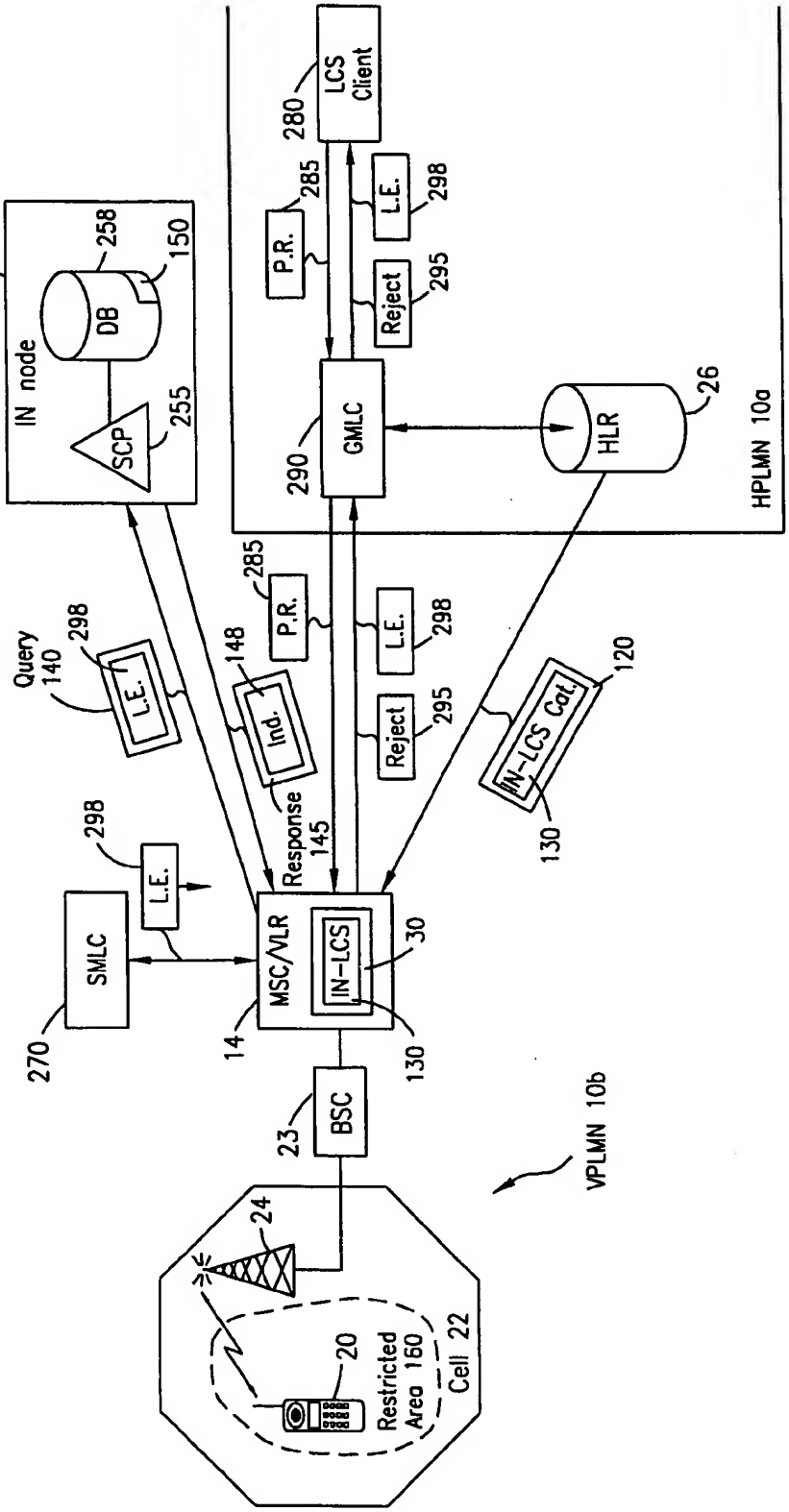

LCS Client
280
P.R.
285
L.E.
298
Reject
295
GMLC
290
HLR
26
HPLMN 10a
250
IN node
DB
258
150
SCP
255
Query
140
Ind.
148
Response
145
IN-LCS Cat.
120
130
SMLC
270
MSC/VLR
14
IN-LCS
30
BSC
23
VPLMN 10b
24
Restricted Area 160
20
Cell 22

FIG. 3

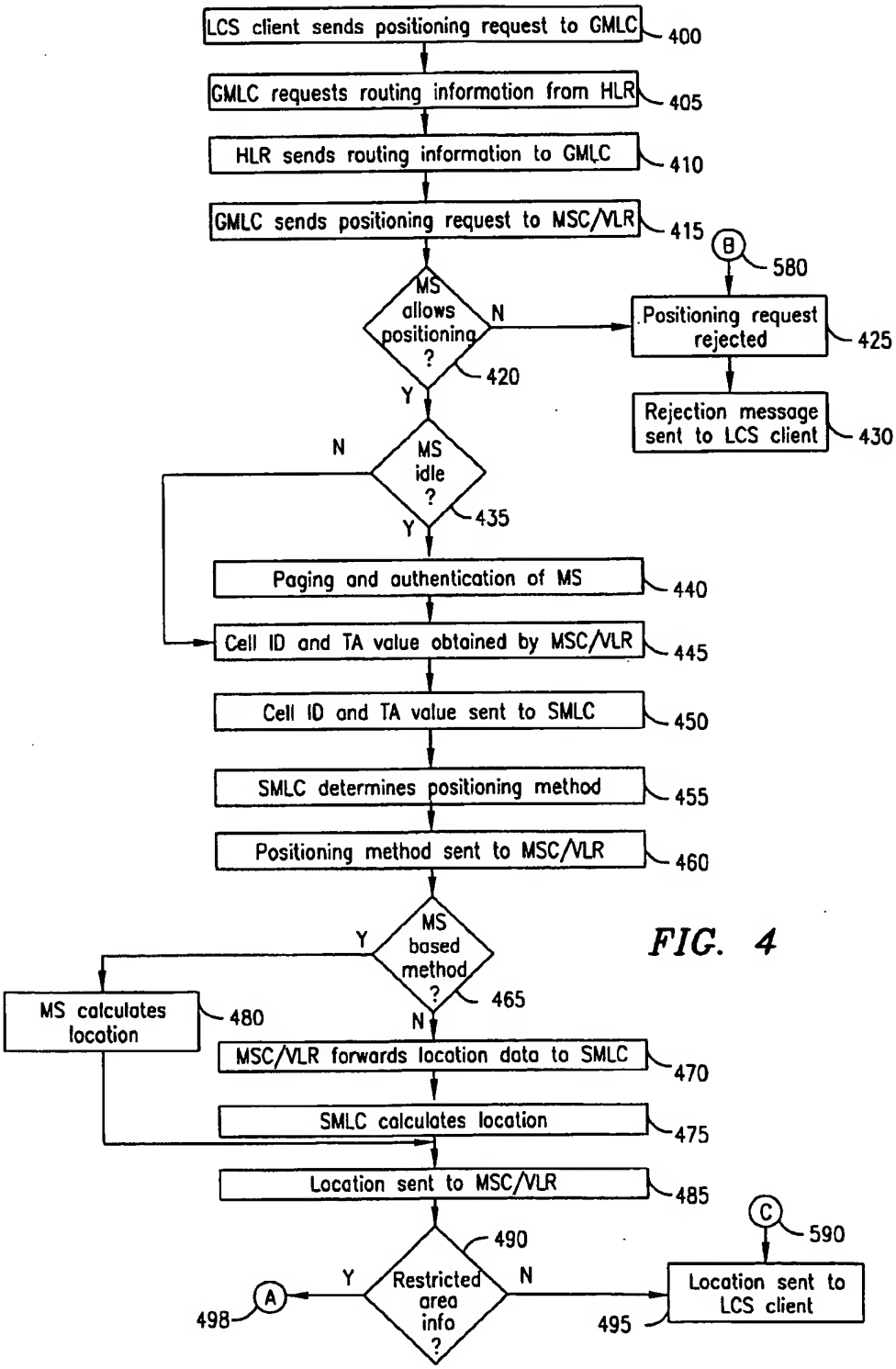

LCS client sends positioning request to GMLC
400
GMLC requests routing information from HLR
405
HLR sends routing information to GMLC
410
GMLC sends positioning request to MSC/VLR
415
B
580
MS allows positioning ?
420
N
Positioning request rejected
425
Rejection message sent to LCS client
430
Y
N
MS idle ?
435
Y
Paging and authentication of MS
440
Cell ID and TA value obtained by MSC/VLR
445
Cell ID and TA value sent to SMLC
450
SMLC determines positioning method
455
Positioning method sent to MSC/VLR
460
MS based method ?
465
Y
N
MS calculates location
480
MSC/VLR forwards location data to SMLC
470
SMLC calculates location
475
Location sent to MSC/VLR
485
C
590
490
Restricted area info ?
Y
N
A
498
Location sent to LCS client
495

FIG. 4

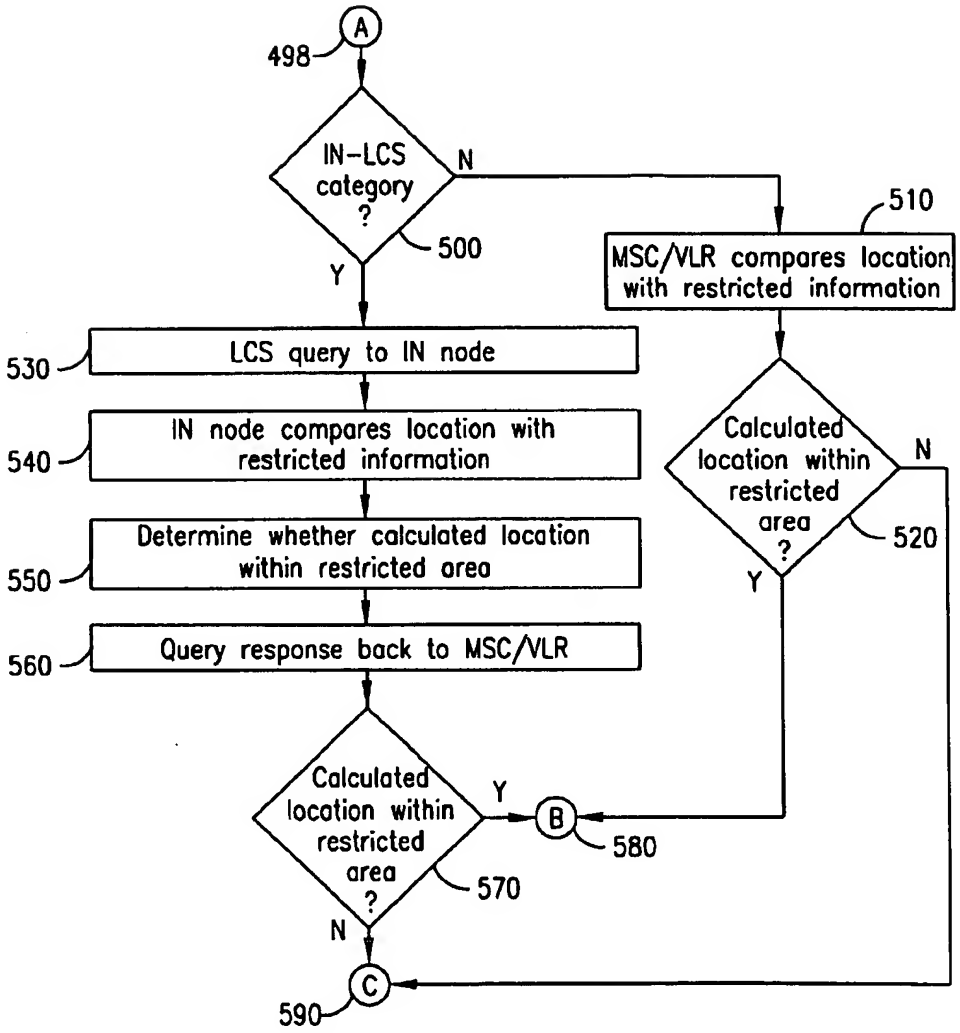

A
498
IN-LCS category ?
N
Y
500
510
MSC/VLR compares location with restricted information
530
LCS query to IN node
540
IN node compares location with restricted information
550
Determine whether calculated location within restricted area
560
Query response back to MSC/VLR
Calculated location within restricted area ?
520
N
Y
Calculated location within restricted area ?
570
Y
B
580
N
C
590

FIG. 5

SYSTEM AND METHOD FOR PROVIDING RESTRICTING POSITIONING OF A TARGET MOBILE STATION BASED ON THE CALCULATED LOCATION ESTIMATE

BACKGROUND OF THE PRESENT INVENTION

Field of the Invention

The present invention relates generally to telecommunications systems and methods for positioning a target mobile station within a cellular network, and specifically to providing position related services based on the calculated location of the target mobile station.

BACKGROUND AND OBJECTS OF THE PRESENT INVENTION

Determining the geographical position of an mobile subscriber within a cellular network has recently become important for a wide range of applications. For example, location services (LCS) may be used by transport and taxi companies to determine the location of their vehicles. In addition, for emergency calls, e.g., 911 calls, the exact location of the mobile subscriber may be extremely important to the outcome of the emergency situation. Furthermore, LCS can be used to determine the location of a stolen car, for the detection of home zone calls, which are charged at a lower rate, for the detection of hot spots for micro cells, or for the subscriber to determine, for example, the nearest gas station, restaurant, or hospital, e.g., "Where am I" service.

In some instances, the mobile subscriber or the cellular network currently serving the mobile subscriber may not want to provide the location information to the requesting LCS client. For example, the mobile subscriber may not want his or her location to be provided when that subscriber is at home, at work or at a location that the mobile subscriber would like to restrict positioning. Likewise, the network may not want to provide location information when the mobile subscriber is in an area that requires secrecy, such as a military base, government office, police station or other area that the network would like to restrict positioning.

Currently, to prevent an LCS client from obtaining location information, a mobile subscriber can define a Subscriber Location Privacy Profile (SLPP), which indicates which LCS clients are allowed to position the mobile subscriber and in which locations those LCS clients are allowed to position the mobile subscriber. However, the allowed or disallowed location (s) can only be defined by network area, such as by cell or Location Area (LA), all of which typically cover a large geographical region. This is due to the fact that the SLPP is only used in an initial determination of whether or not the LCS client is allowed to position the mobile subscriber. This determination is typically performed before the geographical location information is calculated, which requires the determination to be made based upon the network area that the mobile subscriber is currently located in.

If the restricted area covers only a portion of a network area, such as a cell, defining an entire network area as a disallowed area unnecessarily prevents an LCS client from obtaining location information. In addition, if the network determines that a portion of a network area should be restricted from positioning, the network must prevent all positioning from being performed in the entire network area. This is undesirable for both the network and the mobile subscriber.

SUMMARY OF THE INVENTION

The present invention is directed to telecommunications systems and methods for defining restricted positioning areas by geographical location. The restricted area information can be established by the cellular network or the mobile subscriber, and can be stored in a database, such as an Intelligent Network (IN) node. An IN trigger can be included in the subscriber information provided to the serving Mobile Switching Center/Visitor Location Register (MSC/VLR) or the IN trigger can be stored in specific MSC/VLR's that have restricted positioning areas for all mobile subscribers. Upon receiving the calculated location estimate, the IN trigger is activated, and the MSC/VLR transmits the calculated location estimate to the IN node to determine whether the calculated location estimate can be provided to the requesting LCS client based upon the defined restricted area information.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed invention will be described with reference to the accompanying drawings, which show important sample embodiments of the invention and which are incorporated in the specification. hereof by reference, wherein:

FIG. **1** is a block diagram of a conventional cellular network;

FIG. **2** is a block.diagram illustrating a cellular network performing a conventional positioning of a mobile subscriber;

FIG. **3** is an exemplary block diagram illustrating a cellular network providing positioning information associated with a mobile subscriber based upon restricted geographical information, in accordance with embodiments of the present invention;

FIG. **4** is a flow chart illustrating the steps involved in positioning a mobile subscriber; and

FIG. **5** is a flow chart illustrating the steps involved in determining whether the calculated location is within the restricted geographical area, in accordance with embodiments of the present invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

The numerous innovative teachings of the present application will be described with particular reference to the presently preferred exemplary embodiments. However, it should be understood that this class of embodiments provides only a few examples of the many advantageous uses of the innovative teachings herein. In general, statements made in the specification of the present application do not necessarily delimit any of the various claimed inventions. Moreover, some statements may apply to some inventive features but not to others.

With reference now to FIG. **1** of the drawings, there is illustrated a sample cellular network **10**, such as a Global System for Mobile Communications (GSM) Public Land Mobile Network (PLMN), which in turn is composed of a plurality of areas **12**, each with a Mobile Switching Center (MSC) and an integrated Visitor Location Register (VLR) (MSC/VLR) **14** therein. The MSC/VLR **14** provides a circuit switched connection of speech and signaling information between a Mobile Station (MS) **20** and the PLMN **10**. The MSC/VLR areas **12**, in turn, include a plurality of Location Areas (LA) **18**, which are defined as that part of a given MSC/VLR area **12** in which the MS **20** may move

freely without having to send update location information to the MSC/VLR **14** that.controls the LA **18**. Each LA **18** is divided into a number of cells **22**. The MS **20** is the physical equipment, e.g., a car phone or other portable phone, used by mobile subscribers to communicate with the cellular network **10**, each other, and users outside the subscribed network, both wireline and wireless.

The MSC/VLR **14** is in communication with at least one Base Station Controller (BSC) **23**, which, in turn, is in contact with at least one Base Transceiver Station (BTS) **24**. The BTS is the physical equipment, illustrated for simplicity as a radio tower, that provides radio coverage to the cell **22** for which it is responsible. It should be understood that the BSC **23** may be connected to several BTS's **24**, and may be implemented as a stand-alone node or integrated with the MSC/VLR **14**.

With further reference to FIG. **1**, the PLMN Service Area or cellular network **10** includes a Home Location Register (HLR) **26**, which is a database maintaining all subscriber information, e.g., user profiles, current location information, International Mobile Subscriber Identity (IMSI) numbers, and other administrative information, for subscribers registered within that PLMN **10**. The HLR **26** may be co-located with a given MSC/VLR **14**, integrated with the MSC/VLR **14**, or alternatively can service multiple MSC/VLRs **14**.

As can be seen in FIG. **2** of the drawings, for conventional positioning of a particular MS **20**, upon the reception of a positioning request from a Location Services (LCS) client **280**, the MSC/VLR **14** sends a Mobile Application Part (MAP) PERFORM LOCATION message to a Serving Mobile Location Center (SMLC) **270** within the PLMN **10** associated with the MSC/VLR **14**. The SMLC **270** is responsible for carrying out the positioning request and calculating the MS **20** location. Thereafter, the SMLC **270** determines the positioning method to use. For example, the SMLC **270** can use a number of different positioning mechanisms, including, but not limited to, Timing Advance (TA), Time of Arrival (TOA), Enhanced Observed Time Difference (E-OTD) or Global Positioning System (GPS).

After the SMLC **270** determines the positioning method to use, the SMLC **270** instructs the MSC/VLR **14** to obtain raw location data using the determined positioning method and return this raw location data to the SMLC **270**. Thereafter, the SMLC **270** calculates the MS **20** location and returns this location estimate to the MSC/VLR **14**. In turn, the MSC/VLR **14** forwards the location estimate to the LCS client **280** that requested the positioning. It should be noted that the requesting LCS client **280** could be located within the MS **20** itself, within the MSC/VLR **14** or could be an external node, such as an Intelligent Network (IN) node. If the LCS client **280** is not within the MS **20** or within the MSC/VLR **14**, the location estimate is sent to the requesting LCS client **280** via the MSC/VLR **14** and a Gateway Mobile Location Center (GMLC) **290**.

With reference now to FIG. **3** of the drawings, in order to restrict the positioning of a mobile subscriber within a specific geographical area **160**, restricted area information **150** associated with the geographical area **160** can be defined by either the network operator or the mobile subscriber. If the restricted area information **150** is defined by the network operator, the restricted area information **150** can be valid for any mobile subscriber being positioned within the restricted geographical area **160**. In addition, this restricted area information **150** can be stored in the MSC/VLR **14** serving the restricted area **160** or within an external node, such as an IN node **250**, the latter being illustrated.

However, if the restricted area information **150** is defined by the mobile subscriber, this restricted area information **150** only applies to that mobile subscriber. In this case, the restricted area information **150** can be stored in the HLR **26** associated with the mobile subscriber or within the IN node **250**, the latter being illustrated. The restricted area information **150** could be, for example, a set of coordinates, a set of coordinates along with a defined radius around that set of coordinates or at least three sets of coordinates that define the geographical area **160** encompassed by the restricted area information **150**.

When an MS **20** first registers with a serving MSC/VLR **14**, which could be in the home PLMN **10***a* or within a visiting PLMN **10***b*, the latter being illustrated, the MS **20** sends a location updating message to the MSC/VLR **14**. In response, the MSC/VLR **14** sends an update location message to the HLR **26**, which returns subscriber information associated with the MS **20** back to the MSC/VLR **14** in an Insert Subscriber Data message **120**.

If the mobile subscriber has defined at least one restricted geographical area **160**, the restricted area information **150** can be passed back to the MSC/VLR **14** in the Insert Subscriber Data message **120** and stored in a subscriber record or database **30** associated with the MS **20** within the MSC/VLR **14**. Alternatively, and preferably, instead of sending the restricted area information **150** directly to the MSC/VLR **14**, the HLR **26** can send a new subscriber IN-LCS category **130** in the Insert Subscriber Data message **120**. The IN-LCS category **130** serves as an IN trigger to the IN node **250** housing the restricted area information **150**. It should be understood that if the PLMN **10***b* defined the restricted area information, the IN-LCS category **130** would be provided to the MSC/VLR **14** by the PLMN **10***b* and stored in the database **30** in the MSC/VLR **14**.

With reference now to the steps shown in FIG. **4** of the drawings, which will be described in connection with FIG. **3** of the drawings, once the MS **20** is registered with the MSC/VLR **14**, an LCS client **280** can send a positioning request **285**, which specifies the particular Mobile Station Integrated Services Digital Network (MSISDN) number associated with the particular target MS **20** to be positioned, to the GMLC **290** within the PLMN **10***a* of the LCS client **280** (step **400**). It should be noted that the positioning request **285** can also include the duration and/or number of positionings to be performed.

When the GMLC **290** receives the positioning request **285**, the GMLC **290** sends a request for routing information (step **405**), e.g., the address of the serving MSC/VLR **14** within the PLMN **10***b* that the MS **20** is currently located in, to the HLR **26** associated with the MS **20**, using the MS's **20** directory number as a global title. In response, the HLR **26** retrieves routing information for the MS **20** and sends this routing information to the GMLC **290** (step **410**). Using this routing information, the GMLC **290** transmits a MAP_PROVIDE_SUBSCRIBER_LOCATION message, which contains the positioning request **285**, to the serving MSC/VLR **14** (step **415**).

Thereafter, the MSC/VLR **14** verifies that the MS **20** allows positioning to be performed (step **420**), e.g., by checking privacy information, such as the Subscriber Location Privacy Profile (SLPP), which is also sent to the MSC/VLR **14** by the HLR **26** in the Insert Subscriber Data message **120**. If the MS **20** does not allow positioning (step **420**), the positioning request **285** is rejected (step **425**) and a rejection message **295** is sent to the LCS client **280** (step **430**).

However, if the MS **20** does allow positioning (step **420**), and the MS **20** is in idle mode (step **435**), the MSC/VLR **14** performs paging and authentication of the MS **20**, along with ciphering of the positioning data (step **440**). This procedure provides the MSC/VLR **14** with the identification (ID) of the current cell **22** that the MS **20** is located in, along with a Timing Advance (TA) value for the serving BTS **24** (step **445**). However, if the.MS **20** is in dedicated mode (step **435**), e.g., involved in a call connection, the MSC/VLR **14** obtains the current cell **22** ID and TA value for the serving BTS **24** from the serving BSC **23** (step **445**).

Upon receipt of the current cell **22** ID and TA value (step **445**), the MSC/VLR **14** sends a MAP_PERFORM_LOCATION message, which includes the current cell **22** ID and TA value, to the SMLC **270** associated with the MS's **20** current cell **22** ID (step **450**). Thereafter, the SMLC **270** determines the positioning method to use, e.g., Timing Advance (TA), Time of Arrival (TOA), Enhanced Observed Time Difference (E-OTD) or Global Positioning System (GPS) (step **455**).

Once the SMLC **270** determines the appropriate positioning method, the SMLC **270** sends to the MSC/VLR **14** the chosen positioning method and any assistance data that the MS **20** might need if the MS **20** has the capability to position itself (step **460**). Thereafter, if the chosen positioning method does not involve the MS **20** positioning itself (step **465**), as is shown in FIG. **3**, the MSC/VLR **14** obtains raw location data, such as TA values from neighboring BTSs (not shown), and forwards this raw location data to the SMLC **270** (step **470**) for calculation of the geographical location estimate **298**, e.g., X, Y coordinates, of the MS **20** (step **475**). Otherwise, the MS **20** uses the assistance data provided by the SMLC **270** to calculate its own location **298** (step **480**). This location estimate **298** is passed back to the MSC/VLR **14** (step **485**), which normally forwards the location estimate **298** to the requesting LCS client **280** (step **495**) via the GMLC **290**.

However, if the MS **20** or visiting PLMN **10***b* has defined restricted area information **150** (step **490**), upon receiving the location estimate **298**, a determination is made of whether the calculated location estimate **298** is within the geographical area **160** encompassed by the restricted area information **150** (step **498**). With reference now to the steps listed in FIG. **5** of the drawings, if the MS **20** or MSC/VLR **14** does not have the IN-LCS category **130** associated therewith (step **500**), but rather the restricted area information **150** is stored in the MSC/VLR **14**, the MSC/VLR **14** compares the calculated location estimate **298** with the restricted area information **150** (step **510**) to determine if the calculated location estimate **298** is within the restricted geographical area **160** (step **520**).

If the MS **20** or MSC/VLR **14** does have the IN-LCS category **130** associated therewith (step **500**), the IN-LCS category **130** within the MSC/VLR **14** triggers the MSC/VLR **14** to send an LCS query **140** (step **530**), including the location estimate **298**, to the IN node **250** that stores the restricted area information **150** for the MS **20** or MSC/VLR **14**. It should be understood that the IN node **250** could be, for example, a Service Control Point (SCP) **255** within the IN that has access to a database **258** that stores the restricted area information **150**.

In response, the IN node **250** compares the calculated location estimate **298** with the restricted area information **150** (step **540**) to. determine whether the calculated location estimate **298** is within the restricted positioning area **160** (step **550**). After the determination is made, the IN node **250** sends a query response **145** back to the MSC/VLR **14** (step **560**), including an indication **148** indicating whether or not the calculated location estimate **298** is within the restricted area **160**. By removing the restricted area information **150** to the IN node **250**, the comparison and determination processes do not need to be performed by the MSC/VLR **14**, which reduces the burden on the MSC/VLR **14**.

If the indication **148**.indicates that the calculated location estimate **298** is within the restricted area **160** (step **570**), or the MSC/VLR **14** determines that the calculated location estimate **298** is within the restricted area **160** (step **520**), as shown in FIG. **4** of the drawings (step **580**), the MSC/VLR **14** rejects the positioning request **285** (step **425**) and sends the rejection message **295** to the LCS client **280** (step **430**). Otherwise (step **590**), as shown in FIG. **4** of the drawings, the MSC/VLR **14** transmits the location estimate **298** to the requesting LCS client **280** (step **495**) via the GMLC **290**.

As will be recognized by those skilled in the art, the innovative concepts described in the present application can be modified and varied over a wide range of applications. Accordingly, the scope of patented subject matter should not be limited to any of the specific exemplary teachings discussed, but is instead defined by the following claims.

What is claimed is:

1. A telecommunications system for restricting positioning of a mobile station within a cellular network, comprising:

a database for storing restricted area information associated with a geographical area unrelated to any network area defined by said cellular network; and

a mobile switching center in wireless communication with said mobile station for receiving a positioning request for said mobile station, determining a location estimate for said mobile station and accessing said database to determine whether said location estimate is within said geographical area encompassed by said restricted area information, said mobile switching center rejecting said positioning request in response to a determination that said location estimate is within said geographical area encompassed by said restricted area information.

2. The telecommunications system of claim **1**, wherein said database is within said mobile switching center.

3. The telecommunications system of claim **1**, wherein said database is an Intelligent Network node.

4. The telecommunications system of claim **3**, wherein said Intelligent Network node includes a database accessible by a Service Control Point.

5. The telecommunications system of claim **3**, wherein said mobile switching center has an Intelligent Network Location Services category stored therein, said Intelligent Network Location Services category triggering a query to said Intelligent Network node upon determination of said location estimate.

6. The telecommunications system of claim **5**, wherein said query includes said location estimate.

7. The telecommunications system of claim **6**, wherein said Intelligent Network node compares said location estimate with said restricted area information to determine if said location estimate is within said geographical area encompassed by said restricted area information.

8. The telecommunications system of claim **7**, wherein said Intelligent Network node transmits a query response to said mobile switching center, said query response including an indication of whether or not said location estimate is within said geographical area encompassed by said restricted area information.

9. The telecommunications system of claim **8**, wherein said mobile switching center rejects said positioning request

when said indication indicates that said location estimate is within said geographical area encompassed by said restricted area information.

10. The telecommunications system of claim 5, wherein said Intelligent Network Location Services category is associated with said mobile station.

11. The telecommunications system of claim 5, wherein said Intelligent Network Location Services category is associated with said mobile switching center.

12. A telecommunications system for restricting positioning of a mobile station within a cellular network, comprising:

an Intelligent Network node for storing restricted area information associated with a geographical area unrelated to any network area defined by said cellular network, said Intelligent Network node further for receiving a query including a location estimate for said mobile station, determining whether said location estimate is within said geographical area encompassed by said restricted area information and transmitting a query response including an indication of whether or not said location estimate is within said geographical area encompassed by said restricted area information; and

a mobile switching center in wireless communication with said mobile station for receiving a positioning request for said mobile station, determining said location estimate for said mobile station, sending said query including said location estimate to said Intelligent Network node and receiving said query response from said Intelligent Network node, said mobile switching center rejecting said positioning request when said indication indicates that said location estimate is within said geographical area encompassed by said restricted area information.

13. The telecommunications system of claim 12, wherein said Intelligent Network node includes a database accessible by a Service Control Point.

14. The telecommunications system of claim 12, wherein said mobile switching center has an Intelligent Network Location Services category stored therein, said Intelligent Network Location Services category triggering said query to said Intelligent Network node upon determination of said location estimate.

15. The telecommunications system of claim 14, wherein said Intelligent Network Location Services category is associated with said mobile station.

16. The telecommunications system of claim 14, wherein said Intelligent Network Location Services category is associated with said mobile switching center.

17. A method for restricting positioning of a mobile station within a cellular network, comprising the steps of:

receiving a positioning request for said mobile station at a mobile switching center in wireless communication with said mobile station;

determining a location estimate for said mobile station;

comparing said location estimate with restricted area information associated with a geographical area unrelated to any network area defined by said cellular network; and

in response to a determination that said location estimate is within said geographical area encompassed by said restricted area information, rejecting said positioning request by said mobile switching center.

18. The method of claim 17, further comprising the step of:

in response to said step of determining, sending a query including said location estimate from said mobile switching center to an Intelligent Network node.

19. The method of claim 18, wherein said step of comparing is performed by said Intelligent Network node.

20. The method of claim 19, further comprising the step of:

transmitting a query response from said Intelligent Network node to said mobile switching center, said query response including an indication of whether or not said location estimate is within said geographical area encompassed by said restricted area information.

21. The method of claim 17, wherein said restricted area information is associated with said mobile station.

22. The method of claim 17, wherein said restricted area information is associated with said mobile switching center.

23. A method for a mobile switching center to restrict positioning of a mobile station in wireless communication with said mobile switching center within a cellular network, comprising the steps of:

receiving a positioning request for said mobile station at said mobile switching center;

determining a location estimate for said mobile station;

in response to said step of determining, sending a query including said location estimate to an Intelligent Network node;

receiving a query response from said Intelligent Network node, said query response indicating whether said location estimate is within a geographical area encompassed by restricted area information, said restricted area information being unrelated to any network area defined by said cellular network; and

if said query response indicates that said location estimate is within said geographical area encompassed by said restricted area information, rejecting said positioning request by said mobile switching center.

24. The method of claim 23, wherein said step of sending further comprises the step of:

triggering an Intelligent Network Location Services category stored within said mobile switching center to send said query in response to said step of determining.

25. The method of claim 24, wherein said Intelligent Network Location Services category is associated with said mobile station.

26. The method of claim 24, wherein said Intelligent Network Location Services category is associated with said mobile switching center.

27. A method for restricting positioning of a mobile station within a cellular network, comprising the steps of:

receiving a positioning request for said mobile station at said mobile switching center;

determining a location estimate for said mobile station;

in response to said step of determining, sending a query including said location estimate to an Intelligent Network node;

comparing said location estimate with restricted area information stored within said Intelligent Network node, said restricted area information being associated with a geographical area unrelated to any network area defined by said cellular network;

determining whether said location estimate is within said geographical area encompassed by said restricted area information;

transmitting a query response from said Intelligent Network node to said mobile switching center, said query

response indicating whether said location estimate is within said geographical area encompassed by restricted area information; and

if said query response indicates that said location estimate is within said geographical area encompassed by said restricted area information, rejecting said positioning request by said mobile switching center.

28. The method of claim **27**, wherein said step of sending further comprises the step of:

triggering an Intelligent Network Location Services category stored within said mobile switching center to send said query in response to said step of determining said location estimate.

29. The method of claim **28**, wherein said Intelligent Network Location Services category is associated with said mobile station.

30. The method of claim **28**, wherein said Intelligent Network Location Services category is associated with said mobile switching center.

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